Universitat de Girona
Facultat d'Educació i Psicologia

SOLVING THE HUMAN PUZZLE:
LET'S DISCOVER THE INTERRELATIONSHIP
BETWEEN THE SYSTEMS IN OUR BODY

Combination of CLIL and PBL methodologies to promote an active learning in Biology contents

Màster en Formació del Professorat d'Educació Secundària Obligatòria i Batxillerat, Formació Professional i Ensenyament d'Idiomes (MUFPS)

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1. Introduction

1.1. Contextualization

This work aims to combine two different learning methodologies – *Content and Language Integrated Learning* (CLIL) and *Problem Based Learning* (PBL) - in an attempt to establish a motivating interdisciplinary approach – learning both scientific and linguistic contents- in order to improve students' abilities, skills, knowledge and competency-based learning.

Regarding the PBL methodology, I knew it existed, as I have read some articles about it. However, the CLIL learning approach was completely unknown to me right before signing up in the "*Màster en Formació del Professorat d'Educació Secundària Obligatòria I Batxillerat, Formació Professional i Ensenyament d'Idiomes (MUFPS)*" masters at the university of Girona and it has been during this year that I have understood its basis in the different subjects of the masters, specially the scientific-technologic field ones. This immediately caught my attention, as I consider that interdisciplinary approaches on the academic field are basic for improving students abilities to adapt to the changing society where we live. More specifically, I truly believe being able to communicate in foreign languages is basic in the frame of the current globalized world.

The CLIL approach is trying to be implemented in a regular basis in Europe in order to achieve a foreign language knowledge improvement and it is currently well accepted in the European education systems. (Bruton, 2013).

The European Education Area (EEA) is an initiative created by the European Commission (EC) and European Union (EU) with the purpose to improve the national education systems of the Member States and, more specifically, to enhance foreign language acquisition, as they are deemed essential to communicate, interact and find a suitable job in the current market (European Education Area). Nonetheless, research shows that the current approaches are not having the desired effect, as the degree of achievement of language competency and proficiency is low among most of the countries and this is one of the reasons why the EC has created the EEA. The EC has endorsed the need to make changes and implement a singular approach to boost language learning, whose essential points include (European Education Area):

- Focus the learning on the achievement of proper language skills and competences.
- Consider every student's abilities to promote language awareness
- Promote studying abroad experiences for teachers as an opportunity to practice and improve their language skills
- Provide resources to implement innovative, multilingual and inclusive learning methodologies at schools.

In Spain, at least one foreign language is taught, and it is part of the core curriculum options. In 2016, data suggested that only a 10.8% of the time of the curricular teaching was dedicated to learning it. Regarding the learning of a second foreign language, students do not have an obligation to do it but, if they want to,

they have the right to learn it in a curricular basis at the commence of the secondary school the latest. (Eurydice, 2017).

Recent research shows that the current methodologies do not achieve satisfactorily multilingualism goals and the linguistic competences of foreign languages (CCMA, 2021; Zafra, 2019). Some of the reasons for this current trend are the fact that Spain is a relatively poor country (with a relatively low Gross Domestic Product (GDP)) when compared to other European countries (Zafra, 2019). And the large amount of people that nowadays speak Spanish in the globe. Furthermore, other aspects that need to be taken into account are threefold. Firstly, there is a striking difference in the possibility of learning a non-linguistic subject in the English language, with a wide variation among different public secondary schools. Secondly, the fact that in Spain both the publishing and the audiovisual media – including TV series, films, documentaries, etc – are always dubbed also contributes to the reduced use and master of the language. Finally, the third issue is related to the growing disparity among the rich and the poor, with wealthy people having access to private extracurricular English classes that others cannot afford (CCMA, 2021).

The English level of the Spaniard population is low and one of the lowest among the European countries when it comes to English proficiency, as shown in the Education First English Proficiency Index (EF EPI), which is a report that includes a classification of 112 countries and regions based on their English Skills. The EF is a company founded in Sweden that has been annually publishing this index ever since 1965. This year's report has been based on the tests taken by 2 million people, 47% being male and 53% being female, with a median age of 26 years old and almost all of them (96%) being under 60 years old (Education First, 2021).

In this report, Spain is in the position number 25 out of the total 35 countries in Europe and in the number 33 out of the total 112 countries analyzed, with an overall score of 540, which corresponds to a moderate proficiency level. No improvement has been shown in the proficiency degree of the population since 2012 (Education First, 2021). In 2016, the statistics published in Eurostat – the statistical office of the European Union - stated that a 54.3% of the Spaniard population aged 25-64 reported to know one or more foreign languages. Therefore, a 45.7% of the population cannot speak a foreign language (Eurostat, 2021)

During my practicum at the secondary school "*Institut la Miquela*" I had the opportunity to attend some CLIL-based classes and have a deep look into what this approach is like in a real-life situation. This methodology was only applied to the "Geography and Social Sciences" and the "Physical Education" subjects and, although my personal project is focused on applying CLIL in a science subject (Biology), it was enriching to analyze some characteristics and positive outcomes of this learning method.

All in all, learning the theoretical basis of the CLIL methodology combined with having the opportunity to see it applied in a real secondary school setting, led me to decide I would like to design my final masters' project on a CLIL methodology basis. Furthermore, for the purpose and contents of this work, after thoroughly thinking about it and researching, I decided to combine it with a PBL to enhance students' motivation and learning.

Based on all the evidence and the facts discussed above, it is necessary to enhance foreign language learning to enable students to communicate, interact and adapt to the ever-changing world and the society they live in and implementing methodologies such as CLIL on a regular basis is one helpful manner to achieve this purpose. In accordance with the ideas stated above, this final project will be elaborated completely in the English language, with the aim to design a singular didactic unit (DU) in the same language as it would be implemented in a real-life scenario in a secondary school in a location such as Catalunya, where English is not the native spoken language for most of the population.

1.2. Reasons for the singularity of the approach

This approach is singular in the sense that it combines two different methodologies and focuses its attention on the students', as they are the center during the entire learning process: they have to work in groups to solve case-studies related to the contents to be learnt, while practicing at the same time a third language, in the trilingual context in which Catalunya is located. There are no traditional classes, as the teacher does not provide theoretical information, but helps and guides students to learn it by solving the cases throughout the year. It is a singular methodology that enhances students' involvement in the project, as they have to investigate different illnesses and understand, both the physiopathology and the physiology in a more holistic and global way.

For the purpose of this singular programming, which is mainly to promote a global learning on the different systems of the human body as a whole, using an integrative focus, I have slightly rearranged the contents to be learned during the 3rd course of ESO. I have included all the recommended biology contents for this level that appear in the ESO curriculum (Departament d'Educació, 2019), but I have not included the ones related to geology, because of time limitation. This is directly related to the fact that only two hours a week are available for the Biology and Geology at 3rd of ESO, in comparison with other levels, such as 1st and 4th of ESO, which are worked on a 3 hours per week basis. A regular scholar year includes 35 weeks and, therefore, the total amount of hours for the Biology subject would be 70 hours, divided into three trimesters. So, for each trimester, there would be approximately 12 weeks, which corresponds to 24 hours of classes.

I did my practicum at the secondary school in this same level (3rd of ESO) and teachers from there would reassure that this little time for the subject has a huge impact on the amount on contents that can be taught and learned during the course. Therefore, I have prioritized the contents of Biology and I would teach, if possible, the 3rd of ESO Geology contents (mainly the functioning of ecosystems and the human impact and damage to the environment) during the 4th level of ESO, connecting them with other Geology contents that are usually treated at this level (such as ecology, the natural environment and the biodiversity of the Earth). This is totally licit and feasible, as the ESO curriculum document (Departament d'Educació, 2019), clearly specifies that the content distribution within the 4th courses of ESO is only a recommendation and every secondary school center can adapt it if they consider it suitable for their specific purposes and depending on their main resources and organization.

1.3. Objectives of the singular project

• **General objective**: improve the students' understanding and learning of the functions and the interrelation of the human body's biological systems by using a CLIL methodology.

• **Specific objectives:**

- Learn the main characteristics, advantages and disadvantages of the CLIL and PBL methodology.
- Justify the benefits of a CLIL methodology to help students familiarize themselves with the use of English in non-linguistic subjects.
- Apply and combine different learning approaches to promote a competence-based learning in a secondary students' class.
- Implement a dynamic learning approach to ensure students understand the tight connection between the different human biological systems.
- Design a *case study approach* to apply the knowledge to real-life situations in order to solve problems and achieve the related scientific, linguistic, digital and personal and social related competences satisfactorily.

2. Theoretical framework

2.1. Learning approaches

2.1.1. Constructivism theory

The basic principles of constructivism establish that three elements need to interrelate in order to achieve learning: the students – who have to actively participate, the teacher – who acts as a facilitator throughout the process, and the contents to be learnt – based on the cultural knowledge socially established (Gómez-Granell & Salvador, 1994). Piaget is one of the most representative authors of Constructivism and he proposed the theory of cognitive development, which offers a psychological approach regarding the development of cognition in the individuals. (Kitchener, 1986) In this theory it is established that in order to acquire knowledge it is essential to raise a cognitive conflict to the learner, which will lead to a process of adaptation. This cognitive problem is an experience that an individual is uncapable of interpreting by using their mental schemes. This creates an imbalance, which leads to two different mechanisms of adaptation – the assimilation and the accommodation, which promote the learning of the students (Gómez-Granell & Salvador, 1994). Furthermore, in this theory different stages are established based on the age of the learner: the sensor and motor stage (for 0- to 2-year-olds), the preoperational or intuitive stage (for 2- to 7-year-olds), the specific operations stage (for 7- to 12-year-olds) and the formal operations stage (for 12-year-olds and older) (Gómez-Granell & Salvador, 1994).

Ausubel proposed a learning theory that defended that learning should be meaningful and this can be achieved by contextualizing the learning activities in an environment that is close to the students, so that they feel it is real and can be related to their daily lives and, thus, acquiring a significance that increases the learning process (Ausubel, 1983; Díaz y Hernández, 1998).

Bronfenbrenner's ecological systems theory establishes that learning is generated in a specific context and it is achieved by offering students a challenge. Furthermore, this psychologist proposes the existence of four ecological settings for development change: the microsystem, which includes the student's school, peers, neighborhood plat area, daycare center, church group, health services and family, the mesosystem – that are the different relations established between the different microsystems, the exosystem - which includes the neighbors, the extended family, the family's friends, the mass media, the social welfare services and the legal services and the macrosystem – that includes the attitudes and ideologies of the culture. Furthermore, this author states that these contexts are related and need to follow three principles: coherence and respect to the values, beliefs and attitudes, convergence of the development goals and continuity and recognition of the individual's own knowledge in every context (Bronfenbrenner, 1979).

Besides, within the social constructivism, the development zone is defined as the distance between the effective development level (knowledge and cultural tools that the students already master and are able to apply in an autonomous manner) and the potential development level (the cultural tools that the student is able to use with the help of another person such as a professor or a peer with major expertise. Afterwards, if the mediation has been done appropriately, what in the first moment was a potential

development level, at the end of the process ends up being an effective development level, as the student will know how to use the new tools autonomously (Hausfather, 1996). However, it needs to be underscored that the potential level is not a final goal, as once the student has evolved from the potential to the effective level, from this effective level another potential level is defined and the student will be able to achieve it by cultural mediation again. As professionals of the education field, we need to behave as facilitators and the main educational objective is to promote the evolution from the effective level to the potential level by providing all the necessary tools, resources, materials and support to guide the process. Thereby, our main task is based on promoting the mediation along the students' process of learning and in other to construct the knowledge it is essential to take into consideration another important term, coined by Jerome Bruner: the *Scaffolding.* This is a metaphor that includes a building, the workers and the scaffolding. The building represents the knowledge, the workers constructing the knowledge are depicted as the students and the scaffolding represents the teacher (cultural mediator), which supports the structure and constantly adapts to the rhythm of construction of the learner (Ertmer & Simons, 2005; Guilar, 2009). Finally, Bruner introduced the ides of the curriculum and the knowledge acquisition in spiral, which defends this specific structure instead of the idea of learning concepts in a linear an accumulative way. It proposes that in order to increase the learning complexity in a specific field, first it is necessary to construct knowledge in other fields, which will help to come back to the beginning of the first field from a different focus, helping thus access the knowledge with major complexity (Guilar, 2009).

2.1.2. Learning in science education

Some authors expose that, in order to understand how students acquire knowledge it is crucial to consider the social context where this learning happens: the scientific concepts are cultural and teachers have to transmit them by considering the social processes involved, by promoting that students individually comprehend them and critically address the ideas. However, the teacher's task should not be to adapt to the cognitive individual development of every students as this is unachievable, but to teach the group by processes of social transmission and incorporating methodologies to promote the analytic thinking and the scientific reasoning. They also defend that the acquisition of knowledge in formal settings such as the classroom is based on learning ideas that exist in the culture by interacting with the professors, the peers and the books (Leach, & Scott 2003).

They also state the importance of knowing what students think and how the talk about the physical world in order to focus the teaching – establish learning objectives and assessment criteria as well as design didactic sequences to tackle the difficulties and promote a successful learning (Leach, & Scott 2003).

Finally, regarding the learning of scientific disciplines, the existence of a "learning demand" is proposed, which is the difference between the daily life and the scientific ways of students' thinking. It is highlighted that in order to learn science, it is essential to teach students how to internalize the social scientific language, which is the manner to think and talk about the physical world in a way that is different from how they think and talk in their daily lives and to be able to apply it in the proper context (Leach, & Scott 2003).

2.1.3. Motivation

Although there are different aspects that influence the process of knowledge and abilities acquisition, students' motivation towards learning is vital in order to ensure they acquire a meaningful and permanent learning, which is the one that is not forgotten immediately and lasts for a long period of time (Mallart, 2007). Less meaningful learning tasks, such as memorization, require less participation and implication of the students, leading most of the times to decreased levels of motivation and interest. Therefore, engaging students in the class activities is fundamental for the teaching-learning process, as students only learn what interests them. (Pintrich et al., 1993). Different approaches have been proposed in order to enhance this motivation, including designing activities that are close to the students' everyday lives, practical activities, creative activities and the utilization of ICT (Mallart, 2007; Pintrich, 1999).

Motivation is a process that leads human being to behave in a particular manner and it prompts individuals to achieve specific objectives (Brophy, 2004). Motivation should be considered as a fundamental variable when planning the education process, where student should be engaged in class activities, actively participate and be the protagonist of the learning process, as this help maintain the learning over time (Palmer, 2005).

Potentiating and maintaining motivation is essential to maximize the learning potential of the students through all their secondary school years. Furthermore, motivation leads to learning and also the implication and social commitment of the teenagers (Zimmerman & Schunk, 2008).

Self-motivation is one of the five domains in which emotional intelligence is divided – the other four are social skills, social awareness, self-regulation and self-awareness – and they can all be worked from an educational approach (Mallart, 2007 & Goleman, 1995).

Studies show that over the last decades, students are less motivated towards learning concepts related to the scientific field (Anderman & Midgley, 1997; Fortus & Vedder-Weiss, 2014). Therefore, using innovative and motivational approaches in these subjects is necessary to enhance their interest in the topic and engage them in the many different teaching-learning activities. Furthermore, motivating students in the scientific field learning helps them construct their own knowledge and comprehend the topic, as they will get more involved in the learning process if they see the contents and abilities meaningful and useful to be applied in their everyday lives (Cavas, 2011).

2.1.4. Metacognition

Metacognition is a often defined as "thinking about thinking" and it refers to a higher level of thinking in which individuals actively regulate the cognitive processed associated with learning. However, it is a concept difficult to define nowadays, especially considering that currently there are a wide range of different terms to describe it – including metamemory, self-regulation, learning strategies, comprehension monitoring, theory of mind, executive skills, metacognitive knowledge, experiences, awareness and beliefs, etc – which are all usually used interchangeably (Veenman et al., 2006).

In its origin, metacognition was defined as the process of knowing and of regulating one's cognitive processes during learning (Brown, 1978; Flavell, 1979). This capability of regulating and being aware of one's personal learning process has demonstrated to be successful in schools as well as in other higher education levels (Broadbent & Poon, 2015). In the academic settings such as secondary school centers, these self-regulation processes, students' objectives have been established as both essential factors and valuable predictors of their achievement and self-motivation (Fenollar et al., 2007; Geitz & Kirschner, 2016; Zimmerman & Moylan, 2009). The self-regulation of the knowledge and skills acquisition is a process characterized by individuals being determined and being actively involved in planning the approach for a specific task, executing it, monitoring their progress and assessing their own actions and also in regulating their individual ideas, thoughts, behavior and feelings, all with the purpose of achieving their individual goals (Winne, 2018; Zimmerman & Kitsantas, 2014; Zimmerman & Schunk, 2011)

Metacognition has various distinctions but one of the most popular ones is the division in metacognitive knowledge and metacognitive skills (Veenman et al., 2006). The former is related to the process by which an individual regulates their own problem-solving and learning tasks using acquired knowledge about cognitive processes. This knowledge includes the understanding of how learning occurs in human beings and of the different variables of the task – such as the type of activity and the processing steps needed to complete it. Furthermore, sometimes individuals may have an inaccurate metacognitive knowledge and self-knowledge so that it may lead them to be resistant to changes to improve learning strategies (Livingston, 2003; Veenman, 2005). The latter refers to the processes used to control cognitive activities in order to achieve a cognitive goal, as depending on the action of the person different consequences will take place. They enable individuals to regulate their learning process and are based on a feedback procedure, in which individuals monitor their cognitive activities and assess the outcomes (Livingston, 2003; Veenman, 2005). One metacognitive strategy is self-questioning, as it helps individuals make sure that their cognitive goal has been met and that they have comprehend what they needed to (Livingston, 2003).

During the teaching-learning process, it is necessary to center the it in learn how to learn and provide students the necessary codification systems that lead them to an intelligent, productive and creative learning, which is adapted to their context, surroundings and specific variables (Tesouro, 2015). It has been established that effectively teaching thinking strategies and abilities in the schools is of the utmost importance, as it helps optimize intellectual performance. Thereby, students learn how to conceive in a more critical and creative manner, how to effectively solve issues and difficulties, how to decide by themselves, conceptualize and plan accordingly (Tesouro, 2015). A variety of strategies can be used in order to help students learn to learn, which include promoting the self-questioning of one's knowledge and processes carried out before, during and after the learning; developing discussions in class about the strategies used to solve a given task; and examine particular materials showing many different manners of representing the information (map concepts, schemes, personal diaries…) (Tesouro, 2015).

2.2. CLIL methodology

2.2.1. Definition and characteristics

CLIL is a dual-focused methodology that brings huge innovation to the educational field by using and approach that combines language acquisition with learning of specific non-linguistic subject contents, which may be from the scientific field or the humanistic one (Coyle et al., 2010). This focuses on using a foreign language or a language different of the students' native one to instruct them on a wide range of subjects, including Biology, Geology, Mathematics, Arts, Geography, Economy, etc.

This method is not closed and rigid, but adaptable and changeable according to the specific circumstances and the group of students in each classroom and their language competence level, their academic and social achievement status and their specific learning needs.

Some of the key features of this innovative approach are the consideration of the student as the center of the learning process, the active methodology used and the use of a huge variety of tasks (Genesee and Hamayan, 2016).

As commented above, CLIL uses a combination of methodologies and some that have a significant impact on learning include direct instruction, study skills (such as note taking), spaced practice, feedback of the teacher, working on metacognitive skills, working on problem solving skills, reciprocal teaching, concept mapping and worked examples.

Regarding the CLIL framework, the "4 Cs" – coined by Coyle - are of great importance. The 4Cs are the content, the communication skills, the culture and the cognitive skills (Coyle et al., 2010). Besides, the principles of CLIL include the consideration of the language of learning and also for learning:

- <u>Language of learning</u>: it is the content to be taught and is basically the vocabulary to be used in the didactic units and the associated grammar. The teaching strategy does not have to focus on grammar, but on applying the language in contexts that promote the interaction and communication to develop skills.
- <u>Language for learning</u>: this part is related to the acquisition of language that will provide the students with the skills to successfully adapt to a foreign language environment. In order to achieve these skills, CLIL may use activities that include working in pairs or in groups, discussing specific topics, asking and answering questions, reasoning and enquiring, among others. Therefore, the focus is on the meta-cognition process and the progress in competence-based learning.

There are specific characteristics that should be taken into account and applied in order to create an optimal environment for learning and, therefore, ensure a successful and effective mastering of the academic and personal objectives. The five key points are the following (Mehisto et al., 2008):

- Functional proficient in the areas of writing, reading, speaking and listening, considering the adequacy for the specific grade
- Adequate levels of achievement in the non-linguistic subject contents taught using the CLIL language, considering the appropriateness for the specific grade.
- Acquired competences in the areas of writing, reading, speaking and listening in the first language spoken by the students, considering the appropriateness for their age.
- Internalization of the cultural background related to both the CLIL language and the students' first language
- Presence of habits and cognitive and social abilities necessary to be integrated in the current world.

Teachers, in order to create the proper environment in class for the foreign language practice should act as a language mediator between the students and the new content to be learned (Ball et al., 2015).

The European Commission regards CLIL as a prompt for innovating in the learning field and also as a successful approach for enhancing the educational level and quality of all the state members of the European community. Although this authority strongly recommends its implementation all over the countries, the reality it still has a long way to go, as it has only been adapted in few countries and not in a generalized way, as it is not on every country's national education policy (Eurydice, 2017). However, some countries such as Italy have done so, as CLIL must be used in upper secondary schools teaching, as it is demanded by law since 2003 (Cinganotto, 2016)

2.2.2. Advantages and disadvantages

Different methodologies always have their own advantages and disadvantages and the ones related to the CLIL will be discussed in this section.

On the one hand, CLIL depends on a great range of different factors – including the specific context where it is applied – and, therefore, it is thought to be a flexible approach, as teachers can adapt their materials depending on their students' specific needs and objectives of learning, which provides an advantage for the learning process (Bruton, 2013).

Furthermore, it enhances students' motivation and class involvement, as CLIL is task-based and focuses on problems resolution as well as the use and practice of the language. (Bruton, 2013). Also, as the main focus is not on grammatic structures but in the fluency and ability to use their linguistic skills to interact, this helps increase their self-confidence when using a language different from their native one to solve problems and communicate with their colleagues in their personal context, promoting their capacity to interact with native speakers in a given situation (Marsh, 2012). Moreover, students show interest in the culture of the foreign language country, promoting a development of cultural tolerance and respect to others.

The linguistic communicative competences have been shown to be improved by using the methodology, partly because students are motivated to make their own interventions, orally and while working on the

class activities (Pérez Cañado, 2013). Evidence suggests that students who were immersed in a learning process using a CLIL methodology approach, in comparison to students that only learned the foreign language in a linguistic subject without a CLIL perspective, have better linguistic outcomes, including an increased lexis richness, reading comprehension and the ability of using the language in a more sophisticate way (Catalán, 2006).

Another beneficial aspect of the methodology that should be highlighted is the fact that professionals teaching in a CLIL environment tend to be really motivated, as they see this approach as an opportunity to innovate and improve their students' learning by combining different subjects. Therefore, they use a wide range of resources and include the use of *Information and Communication Technologies* (ICT), that may help increase the quality of the education, if the resources are well selected, in the current context where students have continuous access and master the use of diverse technologies (Bruton, 2013).

Besides, research carried out in Spain shows that teachers generally have a positive attitude towards CLIL usage, and they detected different advantages in its application, including the fact that students had the opportunity to speak in a language other than their native one, the possibility to have access to a foreign language resources, the improvement in areas such as vocabulary-related topics and fluency, the general improvement in the English level and skills, which give a basis to communicate with native speakers when going abroad (Guillamón-Suesta & Renau Renau, 2015).

On the other hand, one of the main drawbacks of CLIL is the fact that some students may find it difficult to follow the lessons, given the added difficulty of using a foreign language to learn non-linguistic contents that may already be complex by themselves (Pérez Cañado, 2013). Therefore, teachers have to properly design the learning programme and guide and support students all over the process, to make sure they feel confident on their abilities to follow the classes. This is key for the purpose of achieving a significant and successful learning experience and to avoid students' feelings of frustration or lack of motivation (Coyle et al., 2010).

Besides, analyzing it deeply, another disadvantage of CLIL is that it can be seen as an elitist approach, as some students may feel left out or have less opportunities of learning. Although it is an option opened to everybody, language knowledge level may be a significant limitation for students in order to follow the non-linguistic contents of the class (Bruton, 2013).

Finally, some CLIL teachers may feel insecure by the lack of extensive formation on the approach, especially, if the students in the class have difficulties with the foreign language, as they may end up showing disruptive behaviors. This is why, in these contexts, teacher interaction and collaboration within the educative community is of extreme importance, especially between foreign language teachers and the non-linguistics subject's teachers that apply a CLIL method in class (Pérez Cañado, 2014; Pérez Cañado, 2015).

In relation with what has been stated above, during the research carried out in Spain disadvantages of CLIL were also highlighted by teachers, who reckoned that sometimes they have to face the lack of adapted materials and elaborate them by themselves, the difficulties that arise due to the low proficiency level of

both the teachers and students (sometimes leading to failure to achieve the non-linguistic contents of the specific subject), the insecurity feelings producing a decreased learning rhythm and, finally, the possibility that students may not master the knowledge of specific terms and topic-related vocabulary in their own native language (Guillamón-Suesta & Renau Renau, 2015).

2.3. PBL methodology

2.3.1. Definition and characteristics

The PBL (*Problem Based Learning*) is a learning methodology in which students build their knowledge by working with real-life problems and the main purpose is not to find the solution to the problem itself, although it can be one of the goals. The general purpose is to promote the students' global development and the acquisition of competences and abilities and the creation of a motivational learning environment is key (Barrows & Wee Keng Neo, 2007).

Therefore, this approach focuses not only to the acquisition of knowledge, but also on the global development of the students, so that the final purpose is not the resolution of the problem itself but the knowledge generation in a feedback process (Font-Ribas, 2004), so that adequate assessment tools to measure the learning during the process are crucial (Valero-García, 2007). It aims to enhance students' motivation and participation by the resolution of a problem, the teamwork, the curiosity and the creativity (Elias-Gutiérrez, 2013). PBL promotes the efforts of the students to develop a project or find the solution to a problem and is a learning focus especially adequate for technical fields but it can be applied to other fields of learning as well (Valero-García, 2007).

The approach promotes students use resources and tools to integrate the theory with the practice as well as apply their own abilities and skills in order to find a solution to a proposed problem in a group team (Savery, 2006). From the beginning until the very end, students need to develop a collaborative attitude within their group and learn how to work in a teamwork situation. This methodology helps students achieve meaningful learning and know how to discuss and exchange their own ideas, negotiate actions to take, deal with difficulties along the way and reach an agreement to achieve a common goal, all of these promoting a successful learning (Barron & Darling-Hammond, 2008). Furthermore, this working environment promotes students master the organization, inquiry and synthesis processes, promoting students build their own knowledge through a motivational approach (Hmelo-Silver, 2004).

It is a fact that context plays a key role in the process of learning and it is crucial for the knowledge acquisition and the abilities development. The PBL approach is based on the constructivist idea that a cognitive conflict stimulates learning, as it implies having a specific intellectual goal and is essential when considering not only what students learn, but also how they learn it (Savery & Duffy, 2001).

The problem presented is the beginning of the entire process and its design is key to ensure a successful learning (Branda, 2009). The teacher is the figure who prepares and poses a problem to students, establishing the beginning of the learning process (Font-Ribas, 2004). Furthermore, the professor has to

provide students from the beginning a guidance on the timing of the activities, the documents to be handed in and the assessment tools, so that students can regulate themselves (Calabuig-Serra, 2010; Ertmer & Simons, 2005).

Afterwards, students have to meet specific objective and they need to analyze the situation and organize themselves to achieve the specific goals (Font-Ribas, 2004), so they actively participate in their learning process at all times. The teacher facilitates the process, guiding the students, offering suitable resources and controlling the timing (Elias-Gutiérrez, 2013) and the figure of the professor is key to help students overcome difficulties that may arise during the process (Valero-García, 2007).

The problem presented need to have two main characteristics, which are familiarity – students already have everyday life information about the topic described, and contextualization – the described issues are presented in an easily identifiable context (Font-Ribas, 2004).

There are different aspects that need to be considered when proposing a PBL to the students in order to promote its success for the purpose of learning: the problem has to be interesting for the students, the groups should include three or four students – which will work individually on some specific tasks as well as within the group, there should be a formative and continue assessment to provide feedback to students in order to review their own work and the teacher should motivate students' participation and provide different resources (Mergendoller & Thomas, 2005; Hung, 2008; Michaelsen & Sweet, 2009).

2.3.2. Advantages and disadvantages

On the one hand, PBL has reported several advantages for the possibilities of learning. These include enhancing the interaction between students and teachers, increasing the motivation towards learning, promoting critical-thinking and reasoning skills, facilitating a meaningful and lasting learning, promoting the autonomy and decision-making process of students, providing learning tools to face different situations throughout life, contributing to the development of effective communicative abilities and enhancing abilities to work in a team (Kokotsaki et al, 2016; Barrows & Wee Keng Neo, 2007). Teachers also report that the PBL methodology is a student-centered learning where students are active learners and it contributes to create a sense of community and collaboration within the class (Aksela & Haatainen, 2019). Additionally, PBL helps building students' self-esteem and motivating them, as they show enthusiasm and engagement in the work (Aksela & Haatainen, 2019).

On the other hand, various disadvantages have also been highlighted. Some of these are the fact that most of the times this approach requires bigger efforts from the teachers as well as more dedication from the students, the raise of conflicts within the groups and the fact that requires an accurate planification and design of the materials (Kokotsaki et al, 2016; Barrows & Wee Keng Neo, 2007). Teachers also report that time management and the project organization as well as the need for professors to have specific skills are remarkable downsides of the methodology (Aksela & Haatainen, 2019). Besides, the lack of resources such as space, equipment, time and ICT were also underscored as significant drawbacks. Finally, regarding the specific challenges related to students, motivation was the main aspect, as sometimes teachers may have

difficulties in providing proper guidance to students in a balanced way, so that they provide opportunities and offer tools without being too restrictive, and also because for some students it may be challenging to work in an established group (Aksela & Haatainen, 2019).

3. Didactic programming overview

3.1. Secondary school contextualization

This project is designed to be applied at a specific secondary school center, which has its own unique and specific characteristics. The center is the public secondary school *La Miquela,* which is located in the small rural village of Bescanó (Girona) and is surrounded by a natural environment, including mountains, forests and farmlands. Most of the population (about 90%) are from Catalonia, 8% from Spain and 2 % from foreign countries (mainly from South-America and Africa) and the language spoken by most inhabitants and used to communicate in religious, cultural and sportive activities is Catalan.

The secondary school center is relatively small, with 2 groups for the education level of 1st of ESO, 3 groups for the levels of 2nd, 3rd and 4th of ESO, 2 groups for 1st of *Batxillerat* and 1 group for 2nd of *Batxillerat*. There is a total number of 36 teachers and 347 students.

A significant part of the families have secondary or university studies and they have a medium-high socioeconomic level, which explains some of the particular features of the center, which enables them to make specific projects that need some special resources. In the center, all students have access to technologies and TIC and own an iPad individually and, thereby, iPad and apple TV are used for teaching most of the subjects and for a wide range of activities and didactic methodologies. Besides, in this center CLIL methodology is used to teaching the subjects of physical activity and geography only for a group of students ant not to the entire group class.

My project is a proposal to be implemented in this context, where students have access to TIC and a personal electronic device and where the school is already familiarized with the CLIL approach, as it is offered to learn other subjects already. Thereby, following the school method, this project, in principle it will not be implemented to the three groups of the education level of 3rd of ESO, but to a split group mixing students from the three groups. All the students willing to take part in this CLIL approach will be included in the group, providing them educational care measures if they have any special needs to meet them and make sure they can successfully learn.

3.2. General didactic methodologies and activities for the teaching-learning process

Throughout the course, in order to work on both the contents and the contents, different didactic methodologies will be combined and used in order to acquire the maximum learning potencial. These will include the CLIL methodology and the PBL methodologies as well as the usage of TIC and learning by discovering.

Real-life cases, problems, questions and cognitive conflicts will be constantly presented to students in a contextualized framework, in order to promote the involvement in their own learing process. It is essential to do so in order to ensure students identify these problems as theirs and see their applicability, so that they can apply the acquired – both linguistic and non-linguistic competences in their daily lifes. Furthermore, debates will be introduced in class in order to enhance scientific reasoning, critical thinking skills and the ability to defend their own ideas by using previous knowledge as well as recently learned

contents along with their capacity to solve difficult situations and put forward proposals for the specific issues that arise in class.

During the scholar year, students will be asked to elaborate and orally present contents related to the various didactic units and different options will be provided in order to make sure all the students have the opportunity to use the more suitable resources for their own interests, abilities and skills. For example, they will have a wide range of possibilities to present the information, such as a video, a power point presentacion, a concept map, a leaflet, a poster or a dyptic. Additionally, they will also be asked to promote specific informative programmes for the school to raise awareness among the different classes in topics including – but not limited to - the prevention of chronic diseases' development, the basis of healthy nutrition, the causes and consequences of substance abuse (tobacco, alcohol and other drug consumption) and risky behaviours frequently associated with the youth.

The more content-focused classes, which will be aimed at learning the basic physiology of the different human systems will always be combined with activities and tasks as well as a case-study approach, to enable the application of the knowledge, thus promoting a real-life, contextualized and utterly competence-based learning.

Ususally CLIL classes have a reduced student ratio, as not all of them want or feel confident enough to take a non-linguistic class in English, which results in more flexibility for the teacher to provide a more personalized and individualized attention to each group of students and, therefore, an in-depth analysis of each case-study can be made. Otherwise, if a large number of students is present at class, division in the group in two smaller subgroups would be encouraged in the school schedule, at least one of the two weekly hours of the subject.

Finally, one-day field trips to the surrounding and near areas of the school will be organized in order to ensure students interact with their surroundings and understand the applicability of the contents to the real life. Therefore, prioritaztion will be given to working in conjunction with local entities, especially which may have a relationship with the huma body contents learned over the course. A prime example of these would be the collaboration with the Red Cross, especially when learning about the circulatory system, and the local hospital, to have an insight into some diseases worked in the class case-studies.

3.3. Students' distribution in the classroom

Over entire course, with the exception of specific moments in which a different student agroupation may be needed, during all the classes students will be distributed in groups, ideally forming a circle, so that interaction between all of them is easier, enabling communication, sharing of ideas and collaboration for a common purpose. Besides, a big circle will be arranged when debates are proposed by the teacher, so that they can all see each other when discussing ideas and sharing opinions. The classical distribution of students seating all in rows and the teacher at the front explaining contents will be avoided, as it forms barriers that curb the learning potential, and when session discussions are proposed the clas will be organized in a circle, so that everyone can see each other and interact more effectively.

3.4. Universal and additional measures for the educational care

Regarding the universal and additional measures for the educational care it should be highlighted that, in general, the students with specific educational care needs (NESE, which stands for *Necessitats Específiques de Suport Educatiu* in catalan) will follow the same class structure and will carry out the same activities as the other students in class. Nonetheless, activity modification and adaptation will be planned to meet the specific needs of the students of the 3rd of ESO class where this didactic programming would be implemented: there are two students with high capacities (HC) and ones student with autism spectrum disorder (ASD).

In order to ensure propper support to the HC students additional resources will be handed in, which will include complementary exercises with a higher level – they will require these students to thoroughly analize and critically address the information and it will enable them to develop their critical-thinking and reasoning skills. Furthermore, at the beginning of the didactic unit, along wit the syllabus (Annex 1, pg 49), an additional card will be provided, named "Do you want to know more?" (Annex 6, pg 65), which will include different links to topic-related websites, videos, news, documents, etc, in order to help them broaden their knowledge on the subject. Furthermore, methodologies will be flexible and will put forward specific projects or problems in order to arouse the interest of the students, and, thus, avoid being feeings of boredom during the classes. Thanks to the CLIL and PBL approach, the classess will enhance students' motivation as they will have to promote teamwork to solve different issues, helping them develop different abilities, including the critical thinking skills, team management skills and metacognition process – a term that describes that students regulate themselves their learning process - by working autonomously in the extra activities provided by the teacher. Besides, as there are two students with HC, sometimes they will be asked to work in pairs to promote the discussion, joint reflection and exchange and ideas and viewpoints. The resources provided will include scientific articles previously selected by the teacher and current newspaper news that may arise over the year and documentaries as well as controversial articles to critically comment on and links to websites to depeen the knowledge in topics that may not be thoroughly analysed in class. Finally, students will be provided with the oportunity to develop a work to deepen in a topic related to the didactic unit besides the contents learned with the rest of students.

In regards with the ASD student, specific aspects will be consider when it comes to planning and explaining the class development to the students, to make sure they fully integrate and follow the lessons. At the beginning of every session, a detailed explanation of the expected lesson development, including the timing (highlighting the exact minutes) spent to each part of the class and the methodology to be used (if there's going to be a teacher presentation, a debate, a teamwork approach, the use of specific digital tools…). This information will be written in the whiteboard so that the student can go back to it and remind themselves about it to avoid feeling feelings of distress and loss of control.

Furthermore, if it is deemed necessary, adaptations will be made, for example ensuring this students follows the same methodology invariably to enhance a routine in class that helps them make comfortable. However, the annual programming approach would be quite advantageous for this student, as all the didactic units will follow a similar pattern to gain an in-sight on the different human body systems with

changes in the contents, vocabulary and case-study but wit common methodological approaches to make the learning of each system more consistent in order to globally understand their interrelationship. Finally, the teacher will provide individualized care to this students each day, talking with them for some minutes to guide them and make sure the student has thoroughly understood the guidelines and knows what he is expected to do in class.

Finally, it needs to be highlighted the fact that this didactic programming is based on the *DUA* (*Disseny Universal d'Aprenentatge* in catalan – Universal Design of Learning), (Departament d'Educació, 2016) as it is designed in a way that makes sure that students are informed about the functioning of the classes and gives them multiple resources. Firstly, different ways of representing the information are provided, enabling students to present the contents worked in class in a flexible and personalied manner and depending on their own abilities and preferences. A prime example of this is the fact that students will be given freedom to decide the final product for their case-study oral presentation, so that they can use a card, an inphographic, a leaflet, a dypthic, a video, a power point presentation, etc. Furthermore, the teacher is constantly guiding the students and supporting them to help them understand, analyze and process the contents and achieve thinking strategies, all by promotinc debates and critical thinking in the class environment. Secondly, the didactic units ensure that the students have the appropriate strategies to successfully achieve the learning objectives. This is accomplished by the support of the teacher, who provides various learning resources as wells as tools to assist students in planifying and establishing their own objectives. An example of this are the guidelines and syllabus (Annex 1, pg 49), handed in to students from the beginning, so that they can regulate their own learning process htough metacognition and have the capacity to carry out a self-evaluation. Finally, a wide range of strategies are utilised to raise student's motivation and promote their active implication in their own learning process. This is mainly fulfilled by promoting peer collaborative work and the proper communication to perform specific tasks satisfactorily, by providing positive feedback to maintain students' motivation and desire to learn, by encouraging student participation in the debats and also by potentiating the reflection on both individual and group progress using self-evaluation rubrics.

3.5. Materials and resources

At the commence of the scholar year, during the first Biology class, students will be given a syllabus that will include the planning of activites along with the objectives and assessment tools used, to provide them a general overview of how the course will develop. The teacher will comment on the information and solve any doubts that may arise. Afterwards, the groups of students will be formed, based on the teacher criteria, so that the following class they will start the teamwork, which will continue along the entire year.

Additionally yo the syllabus, at the beginning of each didactic unit, students will be handed two extra materials with specific details: a leaflet, which will include the syllabus (Annex 1, pg 49) for the specific didactic unit, including the objectives of the unit, the specific assessment tools, the topic-related key words and vocabulary and some other considerations (such as the students' distribution, the time to be spend on the unit, etc); and a card (Annex 2, pg 50), which will provide a visual description of the steps and process to be followed during the lessons of the specific didactic unit. It will be designed in a visual and appealing

way, as includes topic-related images and colors, with the goals of enhancing students' motivation and providing all the essential information needed to follow the didactic unit lessons all in one place.

Throughut the cours, both paper-based and digital resources will be combined to learn the contents of each unit, making the most of the available technological resources of the secondary school center, which include iPads (every student has its own one) and apple TV, enhancing therefore the usage of TIC.

The resources and materials to be used include computers, iPads and projector, the Science Bits website, the digital space *Classroom* (where the teacher includes materials and tasks and the students can download and upload them, respectively), the Internet, digital applications and tools (power point, word, canva, design wizard, Body planet…) to elaborate materials, posters, DINA3 postcsrds, videos, one-day trip's task, assessment tools, self-knowledge questionnaires and different websites of interest.

3.6. Assessment tools

In order to collect evidence of the students' learning different rubrics will be used as the main formative assessment tool. On the whole, they will enable the teacher to categorize each student's learning in the gradation level 1 (satisfactory), 2 (notable) or 3 (excellent) of the competences' achievement level indicators. Consequently, thanks to the evidence provided the teacher will be able to determine if the students has a NA (non-achieved; *No assolit* in catalan), a SA (satisfactory achievement; AS – *Assoliment Satisfactory* in catalan), a NA (notable achievement; AN – *Assoliment Notable* in catalan) or an EA (excellent achievement; AE – *Assoliment Excel·lent* in catalan) learning.

There will be assessment rubrics that will have to be filled in by both the teacher and the students. Firstly, the professor will design a rubric to assess the students' oral presentations of each didactic unit case-study and another one to continiously assess the students work in the teams on a daily basis. Secondly, the students will be asked to complete a co-assessment rubric of the other students' group exposition as well as a self-assessment rubric of their own work and participation within their group. These two last rubrics will particulary contribute to the development of metacognition, so that the students will be able to regulate their own learning process, by answering to questions such as "what have I learned?", "how have I learned it?", "what has been new for me?", "what has been the most difficult and the easiest thing?" and "how will this learning be helpful for me?".

Furthermore, the teacher will use a rubric with a table format, in which they will indicate the observed frequency (almost never, sometimes, often, very often) of the students' attitude in relation with the specific achievement level indicators of the personal and social field. This will enable to assess the competences related to this field, from the self-knowledge dimension, the class participation dimension and the learn to learn dimension. Aditionally, brief self-knowledge questionnaire will be implemented when deemed adequate to promote students' self-reflection on their personality, abilities, and strengths and weaknesses.

Besides, students will have a digital learning diary, where they will include their reflections on what they have learned and which abilities, skills and competences they have developed in each didactic unit as well

as their strenghts and weaknesses, which will be another evidence to assess the students' progress. It will be handed in through the virtual *Classroom* for the teacher to read it.

Finally, at the end of the course there will be a short assessment "exam", which will be completely competence-based, as it will propose problems related to the real-life in a contextualized manner, and students will need to apply the abilities, skills and knowledge acquired throughout the course to "solve the puzzle". Thus, it will be the last part of the course, in which they will work to understand the human body as a whole. The development and reasoning of the answers will be taken into account and will be given more importance than the final results itself.

3.7. Didactic units' distribution

The annual programming for the 3rd of ESO biology subject would be divided in 11 didactic units, which would be grouped in 3 main blocks: the relationship function (includes 3 DU), the nutrition function (includes 4 DU) and the reproduction functions (includes 2 DU). Furthermore, the annual programming would include an introductory DU - which would be worked on before starting with the 3 blocks, and a final didactic unit – which would take place at the very end of the course, to integrate all the DU.

The present project will develop in detail one of the didactic unit of 3rd of ESO, corresponding to the circulatory system, which is the DU number 6 and is included in the nutrition function section. The other DU related to the nutrition funtions are the digestive system (DU5), the respiratory system (DU7) and the excretory system (DU8). Students will have already worked on the digestive system and, therefore, will have the proper abilities and knowledge to work on some questions related to this system within the DU6. All the Didactic Units will be taught in a coherent interdisciplinary manner in order to meet the goal of having an understanding of the interrelationship between them.

The annual programming with a detailed distribution and timing of all the didactic units among the whole course can be seen in the Annexes (Annex 13, pag 80).

4. Detailed development of the singular didactic programming

4.1. Didactic unit overview and curricular contents

Field	Subject	Education level	Scholar year	Trimester	Professor
Scientific-technological (ST)	Biology and Geology	3rd of ESO	2021-22	2nd	Anaïs Matas Ayala

Title	*"How are the cells organized in our body? In biological systems! Let's solve the puzzle!"*	*Didactic Unit 6*	*The circulatory systems*
Timing	4 weeks with 2 hours of Biology class/week, with a total amount of 8 hours		

Curricular contents	
Scientific-technological (ST) field	Linguistic (foreign languge) field
• Organs and systems that provide nutrients and eliminate waste from the cells: the circulatory system. • Exchange of matter and energy within the cell and its relationship with the cellular functions and the molecules synthesis • The basis of health and diseases. Infectious and non-infectious diseases. • Variables that condition the health-disease binomial and effects of addictive behaviours on individual and collective health. • Healthy and balanced diet. Risky behavior related to food intake.	• Comprehension strategies before, during and after reading: differentiating between relevant and secondary ideas, propose hypothesis, locate key words and identify both the general idea of the text and the specific information • Strategies to plan: brainstorming, organization (concept maps and schemes) and selection of the main ideas by using the ICT (*Information and Communication Technology)* • Writen and multimedia presentations: structuring and multimedia supports and resources • Strategies of planning (sources, information selection, schemes, guidelines) and oral production

4.2. Competences and dimensions

Field-specific dimensions and competences	
Scientific-technological (ST) field	Linguistic (foreign languge) field
<u>Natural phenomena and everyday life inquiry dimension</u> • **Competence 5.** Solve everyday life problems applying the scientific reasoning. <u>Health dimension</u> • **Competence 12.** Adopt preventive measures and healthy habits in both the individual and social level, based on the knowledge of the strategies of detection and the body human responses. • **Competence 13.** Apply adequate preventive measures by applying the scientific knowledge in order to prevent risky behaviours and diseases associated with addictive substance consumption. • **Competence 14.** Adopt healthy eating habits to promote the health and prevent risky behaviours, eating disorders and the diseases associated to them.	<u>Oral communication dimension</u> • **Competence 2.** Plan and produce oral texts from diverse typology appropriate to the communicative situation <u>Reading comprehension dimension</u> • **Competence 4.** Apply comprehension strategies to obtain information and interpret the content of written texts of clear structure from the everyday life, the media and the academic field. • **Competence 6.** Select and use query tools to access text comprehension and to acquire knowledge <u>Written expression dimension</u> • **Competence 7.** Plan written texts of diverse typology using the different elements of the communicative situation

Cross-disciplinary dimensions and competences	
Digital (D) field	Personal and social (PS) field
<u>Tools and applications dimension</u> • **Competence 2.** Use text editing applications, multimedia presentations and data processing applications to produce digital documents <u>Treatment of the information and organization of the learning and working environment dimension</u> • **Competence 4.** Search, contrast and select suitable digital information for the work to be carried out, considering a variety of sources and digital media.	<u>Self-knowledge dimension</u> • **Competence 1.** Become aware of oneself and get involved in one's personal growth process. <u>Learn to learn dimension</u> • **Competence 2.** Know and put into practice strategies and habits that are involved in one's learning process

Interpersonal communication and collaboration dimension	Participation dimension
• **Competence 8.** Carry out group activities using tools and virtual settings for collaborative work.	• **Competence 4.** Participate in the classroom, the secondary school centre and in the environment in a responsible and reflective manner

4.3. Key contents

Key contents (KC)	
Of the scientific-technological field's competences	**Of the linguistic (foreign languge) field's competences**
CK9. Cell model **CK10.** Living being model **CK28.** Relationship function. Immune response. Addictive substances. **CK29.** Nutrition function. Food and nutrients. Diseaes and disorders associated.	**CK3.** Oral production strategies: comprehension, initiation, maintenance and finalization of oral texts. Semiformal and non-formal texts, planified and not planified, digital or in person. **CK8.** Strategies for the comprehension before, during and after reading: differentiate the relevant ideas from the secundary ones, do hypothesis, locate key words, identify the general idea of the text as well as specific information. **CK9.** Search and management of information and linguistic consultation **CK16.** Utilization of dictionaries in both digital and paper format and other electronic tools (spell checker, translator, glossary) **CK22.** Lexis and semantics: usual and specific vocabulary in the academic field as well as general and topic-related vocabulary, synonyms.

Key contents (KC)	
Of the digital field's competences	**Personal and social field's competences**
CK9. Text documents editing tools, multimedia presentations and numeric data processing **CK10.** Audiovisual language: fixed image, sound and video	**CK2.** Cognitive abilities **CK4.** Healthy habits **CK14.** Abilities and attitudes to work in groups **CK19.** Resources and participation tools

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CK13. Sources of digital information: selection and assessment	
CK19. Personal learning dossiers (digital portfolios)	
CK22. Work and collaborative learning environments	
CK24. Lifelong learning: virtual learning environment, resources for the formal and non-formal learning in the network	

4.4. Didactic objectives

Didactic objectives	Related sessions
• Understand the physiology of the elements of the circulatory system (heart, blood vessels and blood cells) by visualizing an explanatory video, using physiology cards and various digital resources.	Session nº 1, 2, 3
• Learn the stages of the blood circulation and its importance to provide O_2 and nutrients and to eliminate CO_2 and waste from the cell by visualizing an explanatory video, using physiology cards and various digital resources.	Session nº 1, 2, 3
• Differentiate infectious diseases from non-infectious diseases and identify their characteristics, causes, symptoms, treatment and preventive measures of the more common non-infectious diseases of our modern society through solving a case-study of a chronic disease related to the circulatory system and by making an oral presentation about its resolution using proper digital tools.	Session nº 4, 5, 6, 7, 8
• Integrate the functions of the digestive system (absorbing nutrients) with the ones from the circulatory system (bringing nutrients to the cells) by working on a case-study of a chronic disease related to the circulatory system	Session nº 4, 5, 6, 7, 8
• Identify the basis of a healthy and nutritious diet, justify its importance for the health and be able to utilize various resources to plan a balanced diet, to adopt healthy lifestyles and to critically considerate the selection of certain foods.	Session nº 4, 5, 6, 7, 8
• Argue the importance of globally having a healthy diet to promote the healthy and prevent the development of chronic diseases in the future by actively participating in the class debates and by the group and individual reflection of a newspaper article related to the topic.	Session nº 4, 5, 6, 7, 8

Assessment criteria and assessment indicators of the ST field				
Assessment criteria	**Achievement level indicators**			**Related curricular general assessment criteria (GAC)**
	Level 1 (satisfactory)	**Level 2 (notable)**	**Level 3 (excellent)**	
Understand the physiology of the elements of the circulatory system (blood cells, blood vessels and heart)	Names the basic elements of the circulatory system (blood cells, blood vessels and heart) and their most basic characteristics in a general manner	Describes the elements of the circulatory system (blood cells, blood vessels and heart) and their most basic characteristics in a detailed manner	Comprehends the physiology of the elements of the circulatory system (blood cells, blood vessels and heart) by describing all their characteristics and interrelating all of the elements	• **GAC2.** Discuss one's point of view regarding specific controversial scientific-technologic issues by critically reading research documents in order to assess the procedures and reasons provided in these papers.
Learn the functioning of the blood circulation and its importance to provide O_2 and nutrients and to eliminate CO_2 and waste from the cell	Understands in a superficial manner the blood circulation process and the importance in providing O_2 and nutrients and in eliminating CO_2 and waste from the cell	Comprehends the entire blood circulation process and generally describes the importance in providing O_2 and nutrients and in eliminating CO_2 and waste from the cell	Comprehends the entire blood circulation process and reflects on the importance of providing O_2 and nutrients and eliminating CO_2 and waste from the cell for the correct functioning of the body	• **GAC3.** Interpret the functioning of the human body from a systemic view, recognising the relationship between the different systems.
Differentiate infectious diseases from non-infectious diseases and identify their characteristics, causes, symptoms, treatment and preventive measures of the more common non-infectious diseases	Identifies the main infectious and non-infectious diseases and names the main causes, symptoms, prevention and treatment	Describes the most relevant characteristics of the main infectious and non-infectious diseases and compares their causes, symptoms, prevention and	Analyzes the characteristics of the main infectious and non-infectious diseases and their causes, symptoms, prevention and treatment, using scientific language and contextualizes them by finding	• **GAC5.** Justify the importance of following a healthy diet by relating it to the cells' nutrient needs and establish the relationship of the different diets with health status

of our modern society		treatment, using plain language	associations with the society they are surrounded with	through practical examples •**GAC6.** Differentiate infectious and non-infectious diseases and be able to explain the causes, prevention and treatment of the most common ones.
Integrate the functions of the digestive system (absorbing nutrients) with the ones from the circulatory system (bringing nutrients to the cells)	Understands both the functions of the digestive system (absorbing nutrients) and the ones from the circulatory system (bringing nutrients to the cells) and interrelates them in a superficial way	Describes the functions of the digestive system (absorbing nutrients) and relates them with the ones from the circulatory system (bringing nutrients to the cells)	Integrates the functions of the digestive system (absorbing nutrients) with the ones from the circulatory system (bringing nutrients to the cells) and analyzes the importance of their relationship	• **GAC11.** Use arguments related to the human body functioning to justify the risks of consuming tobacco, alcohol and other drugs. Value the importance of personal hygiene and healthy habits – including a healthy and nutritious diet, the regular practice of physical activity and sleeping enough – for one's well-being and personal development.
Identify the basis of a healthy and nutritious diet and justify its importance for the health	Names the basic features of a healthy diet and recognizes its importance for health promotion and for preventing the development of diseases	Describes in a detailed manner the basic features of a healthy diet and highlights its importance for health promotion and disease development prevention	Plans a healthy diet adapted the individual needs every person and integrates the function of the most relevant nutrients with health promotion and disease development prevention	
Argue the importance of globally having a healthy diet to promote the health and prevent the development of chronic diseases	Understands the negative effects that an unhealthy diet and lifestyle have on the health and accepts the importance of following a nutritious and quality diet	Analyzes the negative effects that an unhealthy diet and lifestyle have on the health and justifies the importance of following a nutritious and quality diet for the	Reflects on the negative effects that an unhealthy diet and lifestyle have on both the individual and the collective health and plans a nutritious and quality diet for the prevention of chronic diseases	

		prevention of chronic diseases		
Discuss on public health problems of our current society	Briefly comments on some of the issues of an article regarding a scientific topic	Describes in a detailed manner the most relevant issues of an article regarding a scientific topic	Reflects on the most relevant issues of an article regarding a scientific topic and provides detailed recommendations to tackle the issues from the scientific topic	

Assessment criteria and assessment indicators of the linguistic field				
	Achievement level indicators			
Assessment criteria	Level 1 (satisfactory)	Level 2 (notable)	Level 3 (excellent)	Related curricular assessment criteria
Produce a suitable oral presentation for the purpose of exposing information related to the circulatory system	Elaborates brief and simple oral texts referring to very basic knowledge of the circulatory system based on a previous plan and using very simple lexis	Elaborates clear and understandable oral texts referring to academic knowledge of the circulatory system based on some resources and using a basic lexis	Elaborates well-structured and smooth oral texts referring to different academic topics of interest of the circulatory system based on a wide range of resources and using a wide range of lexis, including some complex vocabulary	• **GAC5.** Speak in front of an audience by making brief speeches related to the academic and social fields, by exchanging personal and academic information in semi-formal and informal situations, by reasoning and by participation in discussions
Use strategies to obtain scientific information and to discuss the content of texts of the academic field and the media	Utilizes few strategies to obtain scientific information and provides little discussion of the main ideas and the specific issues of the proposed texts and tasks	Utilizes a fair range of strategies to obtain scientific information and discusses the of the main ideas and the specific issues of the proposed texts and tasks in a critical way and some other times in a superficial way	Utilizes a wide range of strategies to obtain scientific information and critically and thoroughly discusses of the main ideas, the specific issues that raise from the proposed texts	• **GAC6.** Understand and interpret the general and specific information from texts and adapted documents, both in paper and digital format, about various topics of interest of the personal and academic field
Produce, elaborate and develop texts suitable for the proposed task by using digital resources	Produces texts of poor quality, using only few digital resources and without meeting the task requirements	Produces texts of good quality, using some digital resources and meeting most but not all the task requirements	Produces texts of excellent quality, using a wide range of digital resources and meets all the task requirements	• **GAC11.** Use digital resources in a progressively autonomous manner to search for information, produce texts, process and enrich the informative in a creative way

Assessment criteria and assessment indicators of the PS field					
Assessment criteria	Achievement level indicators	Observed frequency			
		Almost never	Sometimes	Often	Very often
Participates in the proposed class activities and debates and cooperates with his/her colleagues in order to promote self-knowledge and to responsibility for his/her own personal growth	Performs and completes the assigned tasks in a responsible manner				
	Shares her/his ideas and opinions with her/his colleagues and teacher				
	Listens to the other students and respects her/his time to take the turn in the class debates				
	Respects others' opinions and suggestions				
	Shows a critical attitude towards analyzing aspects related to his/her own daily life and her/his close surroundings				
	Justifies and reasons her/his actions in the participative learning activities				
	Demonstrates an enthusiastic attitude towards learning and personal growth				

Assessment criteria and assessment indicators of the D field			
Assessment criteria	Achievement level indicators		
	Level 1 (satisfactory)	Level 2 (notable)	Level 3 (excellent)
Produce multimedia presentations by using diverse digital applications in order to explain the physiology of the circulatory system and the physiopathology and characteristics of the related disease (heart attack)	Produces digital presentations applying basic functions of text editing and multimedia presentations in order to explain the physiology of the circulatory system and the physiopathology and characteristics of the related disease (heart attack)	Produces digital presentations applying the standard and varied functions of text editing and multimedia presentations in order to explain the physiology of the circulatory system and the physiopathology and characteristics of the related disease (heart attack)	Produces complex and unique digital presentations combining different standard functions of the digital resources available based on the specific objectives in order to explain the physiology of the circulatory system and the physiopathology and characteristics of the related disease (eart attack)
Build new knowledge through the use of digital applications by using diverse information processing strategies for the information	Creates new knowledge of the functioning of the circulatory system and its relationship with the disease (heart attack) by using basic digital resources	Builds new knowledge of the functioning of the circulatory system and its relationship with the disease (heart attack) by using basic options of specific digital resources in order to achieve the proposed goals	Builds new knowledge of the functioning of the circulatory system and its relationship with the disease (heart attack) by combining de different digital resources available in order to achieve the proposed goals with a higher level of complexity

5. Implementation

5.1. Singular programming based on the CLIL and PBL methodologies

The detailed didactic unit of this project corresponds to the sixth one, which is the circulatory system. The timing for the purpose of having an in-depth view of its functioning and related diseases is 4 weeks, with a total amount of 8 hours. In this trimester, the distribution of hours has been the following: 4 weeks for the digestive system, 4 weeks for the circulatory system, 2 weeks for the respiratory system and finally, 2 weeks for the excretory one.

Following the CLIL methodology, it is basic to design the programming considering the dual focus of the class, so that both Biology contents and linguistic contents are involved in the dynamic and, therefore, are included in the objectives and in the assessment tools. The didactic unit will have its Biology field goals, competences and key contents as well as its English field goals, competences, and key contents (Annex 12, pg 72). This competence-based approach has been elaborated by following the guidelines of the document *Programar per competències a l'educació secundària obligatòria: una eina per a la reflexió pedagògica i la presa de decisions dels equips docents,* which has been elaborated by the Educational Department of the *Generalitat de Catalunya* to help teachers familiarize with this system and guide them in their competence-based programming for the subjects (Departament d'Educació, 2019).

Besides, this didactic unit is not only focused on a CLIL methodology but also combines it with a PBL approach for the purpose of enhancing a competency-based learning and students' motivation and of increasing the learning potential of the sessions, as commented on the contextualization and framework sections.

Furthermore, context is highlighted as one of the key points of the CLIL approach and, thus, it is really important and should be worked with the students, by giving them the big picture to understand how the activities and contents relate to their lives. In this singular programming, in each didactic unit the teacher will provide resources so that students get an overview of the importance and implications of the systems in the overall health. Also, as it will be detailed later in this project, the case-studies will be based on specific diseases and, therefore, a contextualized presentation will be ensured, so that students really feel they are working on a real-life problem of the society and not an isolated classroom task.

Each didactic unit will have its correspondent case-study, in which students will have a case to solve and questions to answer to guide them in their active process of learning. By working on it, they will learn basic concepts (such as the difference between infectious and non-infectious diseases, the cel and tissue system organization, etc) as well as more in-depth view of each human body system worked on each didactic unit. Students will always work in group - which will be the same throughout the year - for the case-study solving and each group will be responsible to do an oral exposition for each system. The teacher will assign each group to a system at the beginning of the scholar year, so that students can organize themselves accordingly. Although all the group will work on the worksheet, only one will present it in front of the class, so that at the end of the year all the groups will have presented at least one system. For example, one

group will expose the information about the digestive system, another for the circulatory system, another for the respiratory system, etc.

In the didactic unit design, careful consideration has been given to the three basic elements of the Constructivism theory. Therefore, based on Piaget's theory of cognitive development, in the proposed activities and methodologies, students' active participation is always enhanced through their involvement in the work groups. This is completely necessary, as learning is an active process of constructing the knowledge that every individual does by themselves and, thereby, students cannot have a passive role in it. The didactic sequence put forward in this project is based on a teaching-learning process centered in the students, as they are the ones to solve a case-study and complete various activities, questions and tasks related to the circulatory system and during this process they progressively acquire the contents and the competences of the specific fields (scientific and linguistic) as well as the digital and personal and social ones, which are basic to contribute to students' self-knowledge and personal growth. Additionally, the different learning rhythms are respected at all the times, with the teacher acting as a facilitator and providing guidance and help any time that is needed. Furthermore, the case-study approach is based on the presentation of cognitive conflicts to students, as challenge to overcome in order to enhance their curiosity and motivation and, therefore, activate the learning process (Gómez-Granell & Salvador, 1994).

Additionally, as the target of this didactic unit are students older than 12 years old, based on Piaget's theory of cognitive development and its stages, the students are in the formal operations stage, in which they will acquire through the proposed activities, formal operations, which are the ones that do not require manipulation but are done on a conceptual way. Thus, the thinking process goes beyond and the students are able to reflect on different topics and theories (Gómez-Granell & Salvador, 1994).

Based on the theory of meaningful learning by Ausubel, the didactic unit has been planned accordingly, as the case-study and proposed activities are included in a context close to the student (appearance of a character of their same age with his father, location of the setting in Girona and Bescanó, which is the village from where the students are from, etc). Proposing this situation that can easily be linked to their lives is a successful manner to improve students' motivation and involvement in the tasks (Ausubel, 1983; Díaz y Hernández, 1998).

The case-study approach proposes a challenge to students, which is necessary for learning, as Bronfenbrenner establishes in his ecological systems theory and, based on this theory, tools, opportunities and support is provided by the teacher to the students to enable them to overcome the learning challenges that arise during the process. Furthermore, based on this author view of constructivism, the didactic unit ensure the different microsystems (mainly family, secondary school center and peers) has the three principles of coherence, convergence and continuity. Ideally, these microsystems would also be coherent with the other three ecological settings for development change of the theory (mesosystem, exosystem and macrosystem), although it it difficult to do so only from the secondary school center, as there are some limitations. Therefore, this didactic unit is focused on its contextualization on the microsystem of the shcool center as well as the class colleagues, promoting the coherence and the respect to others' attitudes, values and opinions and also the convergence regarding the pursue of common objectives (Bronfenbrenner, 1979).

Moreover, the didactic unit is also designed taking into account the *Scaffolding* concept by Bruner. Students are offered different resources to guide their process of knowledge construction, including a step-by-step

card, directionality questions to effectively complete the case-study and the other tasks, a vocabulary list of key words of the didactic unit, as well as plenty of resources to work autonomously and complete the various tasks proposed at class. This was done as a scaffolding method, as students are not experts on the topic and need some guidance of the teacher, who acts as a mediator and gives them support to progressively acquire knowledge, to acquire an effective level, as they will be able to solve autonomously the problems proposed in the tasks in other future situations and, at the same time, thanks to this mediation a new potential level would be established (Ertmer & Simons, 2005; Guilar, 2009).Also, in relation with the knowledge acquisition in spiral, in order to acquire a major complexity when learning the biology-related specific competences and contents, this didactic unit promotes its acquisition by using a interdisciplinary approach, with the interaction with the linguistic field and including aspects such as the written and oral expression as well as the development of their creativity and reasoning skills to present the solution to a problem, so that when coming back to the scientific-technologic field, the knowledge acquired was more complex (Guilar, 2009).

Based on the fact that professors should teach the group of students using processes of social transmission and incorporating methodologies to promote the analytic thinking and the scientific reasoning, this didactic unit focuses on proposing tasks that the students need to solve by using critical thinking skills and reasoning strategies (Leach, & Scott 2003). Thereby, a case study along with other topic-related questions as well as an article analysis task are great manners of achieving the learning purpose. Besides, as the learning in formal environments happens by the interaction between three elements – the student, the teacher and the books – emphasis is placed on working in groups with the guidance of the teacher as well as in promoting class discussions.

Furthermore, as it is essential to know what students think and how the talk about the physical world in order to focus the teaching, it is indispensable to explore their previous ideas and misconceptions regarding the concepts that will be taught (Leach, & Scott 2003). For this reason, in the initial session of the didactic unit, the first part of the class is dedicated to exploring the students' ideas on the topic by asking them to brainstorm and openly explain what they know or think about specific contents in order to increase the learning potential.

Based on what Leach and Scott state regarding the existence of a learning demand, in this didactic unit, the teacher is a figure that identifies the specific learning demands in relation with the contents to be taught in order to guide the students - by proposing different activities, reflections and class discussion – and, thus, help them associate what they have learned with their previous ideas as well as promote they critically use and internalize the scientific social language. Therefore, the final goal is to "persuade" them of the usefulness and applicability of the concepts from a scientific view (Leach, & Scott 2003).

Finally, this didactic unit aims to promote students learn how to learn and develop metacognition skills in order to regulate their own processes of knowledge and skills acquisition. Strategies such as promoting students' self-questioning through a personal diary are applied, as they are useful approaches to enhance intelligence performance (Tesouro, 2015).

All in all, the didactic unit approach, based on the CLIL and PBL methodologies and a teaching and learning model that includes elements from Constructivism theories as well as specific views to promote learning in the scientific field, makes the most of the educational potential within the specific context.

5.2. Didactic unit general overview and development

The circulatory didactic unit will be divided in 4 main parts:

• **First part**

At the beginning of the didactic unit, students will start to explore the basics of the circulatory system, especially its physiology, including the main anatomical structures and related functions.

Before starting with the proposed activities, students will be asked to actively participate in a class discussion, to brainstorm ideas, so that the teacher can do an initial assessment and detect possible misconceptions and the students' previous knowledge on the topic, so that the teacher can detect some areas that particularly need to be addressed throughout the didactic unit.

Afterwards, students will begin to work with different resources provided in order to understand the physiology of the circulatory system. These will include a visualization of an explanatory video about the circulatory system, the use of the "body planet cards" and the combination of information and activities from both the science bites and the BBC Bite Size website.

First, the video will be watched to break the ice and have the first contact with the contents and learn some basic characteristics in a more motivational way. Afterwards, the students and the teacher will read all together the theoretical part of the circulatory system from BBC Bitesize and from Science Bits and combinate it with the use of the body planet cards (in groups of 3-4 students) to see the human body system in a 3D view to have a more real perspective and a deep understanding of it. Then, students will work individually and autonomously on the completion of the Science Bits activities related to the circulatory system, which they can self-correct to regulate their process of learning. Each student will do the tasks based on their own learning speed, adapting it to their unique characteristics and capabilities and the teacher will help them solve any questions or problems that arise during the process.

Finally, in this first part of the didactic unit, students will be asked to do a task, which will consist on elaborating a concept map or an equivalent material (based on their own abilities and skills they have flexibility and can decide the format that suits them best) summarizing the basic concepts and features of the circulatory system that they have been working on during this first part of the didactic unit. It will be a useful resource for them to learn and to keep as a guide for the next part of the didactic unit. They will upload this task to the digital *Classroom* space for the teacher to assess it and suggest any improvements to it.

All in all, this part will focus on learning the basic characteristics of the blood, the blood cells (erythrocytes, leucocytes and thrombocytes) and the blood vessels (arteries, veins and capillaries) as well as the heart structure (cavities and valves). Furthermore, the blood circulation process will be understood as a continue process in which all the organs get blood all the time and students will learn to differentiate between oxygen rich blood vessels and carbon dioxide rich blood vessels. The importance of the circulatory system in providing O_2 and nutrients to the cells and in helping eliminate CO_2 and cell metabolism waste will also

be learned. Finally, a brief relationship between the digestive system (nutrients absorbed) and the circulatory system (brings the nutrients to the cells) will be commented on.

• Second part

Once the first part is done, students will work on the physiopathology of the circulatory system by collaborating in groups of 3-4 persons to work on a case study. The first day of this case-study problem the teacher will assign one of the groups the task of doing an oral presentation at the end of the case-study working process.

The case-study will include different sections. Firstly, there will be the case presentation, in which students will be given all the necessary information about a patient suffering a disease related to the circulatory in order to satisfactorily discover which disease is it and solve the case. Secondly, there will be different questions related to this specific case in which students will need to apply their skills and abilities to look for proper information and to apply the knowledge in a practical way (for example, by elaborating a menu to improve the patient health). This will help them learn and understand both the physiology and physiopathology of the system in an active way, as their role will be center stage and the teacher will only be a guide to help them. Thirdly, there will be a section entitled "let's take action", in which students will also be asked to respond some more questions not specifically associated with the circulatory system related disease, but with the prevention of chronic diseases and the promotion of people's health, as well as connect some aspects of the circulatory system with the previously studied digestive system. As students will have already acquired knowledge about the functions and importance of nutrient absorption, the case-study will include some questions to make students reflect on the connections between the digestive and the circulatory systems, helping them understand their tight interrelationship and mutual dependence for nutrient delivery to the cells. Therefore, over the didactic units, as students build new knowledge, they do not do it in an isolated way, but connecting it with the contents and skills developed in the previous units, helping them achieve the goal of understanding the human body as a whole – solving the human puzzle. All the answers in the case-study worksheet will have to be written in English.

Furthermore, there will be an extra activity, which will consist of reading a scientific article extract and answer some related questions. In this task students will particularly need to apply their critical thinking skills to reflect on it. This assignment will only be carried out by a specific group, which will be the one to do the oral presentation.

• Third part

After the students have had enough time to work on their cases in groups, the previously assigned group will do their oral presentation, using the final product (leaflet, diptych, poster, video…) they consider more adequate, in which they will summaries their answers and will also explain their resolution of the extra activity, so that all the other groups will learn about it, as they have not previously worked on this specific part. The final product will have to be completely in English and students will also be encouraged to present it in English entirely, although they may be allowed to express themselves in their native language if they

encounter serious difficulties or lack the skills to express themselves properly with the foreign one. However, doing it in English will give them higher scores, as it will be taken into consideration in the assessment rubric.

Once they finish the exposition, a class discussion will be held, in which all the groups will be invited to participate and share their ideas and answers to the questions based on the research they have been doing, so that they can learn from each other. At the end of the session, all the groups will hand in the solved case-study for the teacher to have evidence to assess their learning.

• Fourth part

Finally, students will dedicate some time to write down their personal reflection in their digital diary about their work within the group, their abilities, strengths and weaknesses and their learning process itself, by using metacognition focused questions.

5.3. Materials and didactic resources

The materials, resources and activities used for this carefully developed and detailed unit will be similar to the rest of the units of the entire year programming, so that they all will follow a determined model to learn in a structured and integrative way the different body systems, as part of a global approach to the human body functioning.

As commented on the framework section, one of the disadvantages of the CLIL approach is the lack of resources for non-native English teachers who implement this methodology in their non-linguistic classes. Therefore, online resources are of utmost importance and helpfulness if they come from reliable sources and include the adequate contents. Based on this, the circulatory system classes will combine resources and materials - both digital and paper based – from online sources as well as from my own design from scratch.

The materials and didactic resources that will be used to have an in-depth understanding of the functions, importance and diseases of the circulatory system are the following:

- A leaflet containing the syllabus of the Didactic Unit 6, corresponding to the circulatory system. It includes the specific objectives and assessment tools for the didactic unit as well as the circulatory system key words and related vocabulary and also provides other considerations (the students' distribution and the time to be spend on the unit) (Annex 1, pg 49).

- A card entitled *"What are you going to do during the didactic unit?"*. It provides in a visually attractive way the description of the steps that will be followed throughout the development of the DU6 (Annex 2, pg 50).

- Video visualization: explanation about the basic characteristics of the circulatory system and the blood flow (Annex 3, pg 51).

- Body planet card of the circulatory system: body planet is a website with a digital didactic resource by which students can discover the body systems in an interactive way and by having a more accurate vision of the human body, as it provides 3D images and an augmented reality. The secondary school center would pay in order to get a license, which would give permanent access to the usage of the app and the cards. The functioning is the easy and intuitive: students are given the circulatory system card and by using the downloaded app, they scan the picture and a 3D image of the system appears in their electronic devices. The card provides an insight into the heart and the blood vessels, the inside of the heart and both the major and minor circulation, with every part name in English (Annex 3, pg 51).

- Resources from Science Bites: it is an online platform that offers the science-related contents of the secondary school curriculum organized in didactic units. It includes a wide range of multimedia and interactive contents in order to promote an active learning in students and it is competence-based. I have included the use of these resources in the didactic unit because apart from the theoretical physiology part, which also includes short videos that the students can watch, it has auto-corrective activities and assessment tasks that provide students the tools to regulate and organize their own learning process in a more autonomous way. Furthermore, the website has the option of accessing the contents in both Spanish and English and, thereby, is an excellent resource for this CLIL approach, as it provides helpful tools to learn Biology in English (Annex 3, pg 51).

- Resources from the BBC Bitesize website: this section of the BBC offers a wide range of free online resources to work on specific subjects in order to help improve the learning process of students aged 5 to 16. After carefully reviewing it, I have deemed it a suitable resource to be used in the CLIL classes of the Biology subject. It offers clear and suitable explanations for the students' age and related activities of the different human body systems and, for the aim of this didactic unit, the resources that will be used are the ones corresponding to the circulatory system (Annex 3, pg 51).

-Problem presentation: a case-study of a disease-related to the circulatory system. Students will have to discover the diseases and answer different directionality questions to understand its basic characteristics and the relationship of the circulatory system with other body systems, as well as briefly explain the process followed to solve the case. Besides, there will be a section named "let's take action: promoting our health and preventing the future development of chronic diseases", where students will learn healthy habits to prevent the development of chronic disease, as well as related the circulatory system with the previously studied digestive system, to help them integrate the knowledge in a holistic way. Finally, there will also be an article with some extra questions to comment on, in which students will particularly need to apply their critical thinking skills and broaden their knowledge about the circulatory topic and share it with the rest of the class. This extra task will only have to be completed by the group that orally present the case-study of the circulatory system. Finally, at the end of the case-study there will be a vocabulary section, where key words, their meaning and translation will be provided to help students follow the case properly (Annex 4, pg 55).

- Useful resources to work on the case study provided by the teacher (Annex 5, pg 64).

- A card entitled *"Do you want to know more about the topic?: blood donations":* this resource is mainly created as an educational care measure to meet the special needs of the students with high capacities. It includes an extra task to motivate and enhance them, which is based on the elaboration of a digital presentation for the school entrance and the town hall to delve into the importance and benefits of blood donation for society. This will be contextualized in a real-life situation, as students will be asked to do it coinciding with a Red Criss blood donation campaign that will be carried out in Bescanó, which is the village where the secondary school is located. Useful links to websites are provided to guide and help the students find reliable and suitable information (Annex 6, pg 65).

5.4. Assessment tools

There will be assessment rubrics that will be filled in by the teacher and the students. Firstly, the professor will design a rubric to assess the students' oral presentations of each didactic unit case-study (Annex 7, pg 66). Secondly, the students will be asked to complete a co-assessment rubric of the other students' group exposition (Annex 9, pg 69). as well as a self-assessment rubric of their own work and participation within their group (Annex 10, pg 70). These two last rubrics will particulary contribute to the development of metacognition, so that the students will be able to regulate their own learning process, by answering to questions such as "what have I learned?", "how have I learned it?", "what has been new for me?", "what has been the most difficult and the easiest thing?" and "how will this learning be helpful for me?".

Furthermore, the teacher will use a rubric with a table format, in which they will indicate the observed frequency (almost never, sometimes, often, very often) of the students' attitude in relation with the specific achievement level indicators of the personal and social field (Annex 8, pg 68). This will enable to assess the competences related to this field, from the self-knowledge dimension, the class participation dimension and the learn to learn dimension. Aditionally, students will be asked to answer some questions in their digital diary to reflect on their skills, abilities and strengths and weaknesses (Annex 11, pg 71). The reflection on the personal diary, the group answers to the case study as well as the digital activities and summary task elaborated throughout the unit will be used as further evidence to assess the students' progress and learning process.

The rubrics scores will be based on a scale from 1 to 4, in order to help bot the students and the teacher familiarixe with the current punctuation system being used at the secondary school centers, rather than the classical 1 to 10 scale. Scores of 1 are equivalent to a *novel* level, of 2 are equivalent to *apprentice* level, of 3 are equivalent to *advanced* level and, finally, of 4 are equivalent to *expert* level.

5.5. Detailed planning of the didactic unit

A thorough detailed planning of the didactic unit - including the didactic sequence, the teaching-learning activities, the stages of the teaching-learning process, the competences involved in each activity, the students' distribution, the specific materials and resources to be used, the universal and additional measures for the educational care and the assessment tools and the timing – is provided in the Annexes (Annex 12, pg 72).

6. Conclusions and final reflection

CLIL is an innovative approach that uses different resources and materials to enhance the learning of contents related to both linguistic and non-linguistic subjects and has various advantages but also some disadvantages that need to be considered. Noticeable benefits and positive outcomes in the learning process can be achieved if lessons are planned accordingly and resources to guide students' learning – including a proper contextualization and vocabulary helpful resources – are provided, mainly focusing on achieving general skills and competences rather than focusing on grammar or pronunciation.

PBL is another helpful approach to enhance students' active learning and different advantages can be underscored, although this approach also has some drawbacks.

In brief, based on the arguments presented in this project, combining a CLIL methodology with other active learning approaches - such as the PBL methodology - is an effective way to promote a significant, long-lasting and useful learning of scientific contents such as the human biology systems - specifically the circulatory system – as well as contents from linguistic subjects, with the final purpose of acquiring competences from various fields – the scientific, linguistic, digital and personal and social. Furthermore, this dynamic and active learning approach can help students comprehend and have an insight into the interrelation of the human body's biological systems. The combination of digital resources to learn the basic characteristics of a human body system, combined with a case study approach aims to promote a competence-based learning, where students acquire the knowledge and competences in a meaningful, long-lasting and functional manner.

Furthermore, including strategies to promote metacognition is also of the utmost importance to enhance intellectual performance, as this enables them to develop critical-thinking and reasoning skills as well as the capacity to solve problems efficiently, make decisions autonomously, conceptualize, plan and execute actions.

In order to promote learning, teachers should properly adapt the didactic units to meet the students' specific needs and design all their elements – including the objectives, activities, resources and assessment tools – in a way that guides students' learning process. This process should take into account different aspects, such as the consideration of the social context, the promotion of students' interaction and active participation in class and the utilization of methodologies that promote critical-thinking and reasoning skills. Promoting the self-knowledge by using different strategies such as questionaries, where students reflect on their knowledge and the mechanisms used to achieve it before, during and after the process.

It needs to be underscored that this proposal is contextualized in a specific secondary school *La Miquela* (Bescanó, Girona)*,* where all the students have access to technologies and TIC and own an iPad individually. Besides, in this center CLIL methodology is currently used to teaching some subjects of the curriculum only in a group of students and not in the entire group class. Thereby, the application of this proposed didactic unit would be completely viable and easy to implement, as the secondary center has all the necessary

resources (electronic devices and willingness to pay for resources such as body planet and Science Bits) and is already familiarized with the approach and methodology.

After the thorough elaboration and planning of this singular didactic unit within a whole year singular programming, one can conclude that the innovative combination of CLIL and PBL didactic methodologies may be useful to enhance students' motivation, participation and willingness to learn in the classroom, as this approach promotes the constantly active participation of the teenagers and uses different attractive and helpful resources to guide them and support their knowledge and abilities acquisition. Furthermore, this competence-based approach is a great manner of learning scientific contents along with getting immersed in a foreign language and having the opportunity to improve the vocabulary and use of the English language and, therefore, enhancing students' development of different abilities and skills that will be useful for their future and to effectively become integrated in society and in the work environment.

Nonetheless, some limitations of this approach should be considered for its future implementation:

- This singular programming is planned for 3rd of ESO and, as previously stated in the project, this education level has significant time constraints for the subject of Biology and Geology with only 2 hours/week dedicated to it, in comparison to many other subjects, which at least take place 3h/week.

- In this singular programming the utilization of electronic devices such as a computer or an iPad is center stage and some secondary schools have resources limitations and many students may not have access to a personal electronic device. Therefore, this would be a significant restraint that should be considered when implementing this approach in a specific center.

- As stated in the contextualization of this project, the general English knowledge among the young population is quite limited and, therefore, for many secondary school students it may add extra pressure and difficulty to the learning of scientific knowledge that may already be a challenge for them.

- The limited availability of teachers willing to carry out a CLIL methodology and the lack of properly trained professionals on the field of CLIL methodology is another crucial aspect to take into account when planning a CLIL approach combined with other active methodologies such as PBL like proposed in this project.

- This innovative approach is planned to be implemented only in a splitting class, where only some students benefit from this methodology, who are those who have chosen to do it because they have abilities enough to use and communicate in English or find the use of English to learn science appealing, giving them a great chance to enhance their inner linguistic and non-linguistic abilities. Nevertheless, this approach may cause segregation and limitation of opportunities for those taking regular classes. Therefore, the aim should be to implement this methodology in a way that can be followed for most of students.

Therefore, specific adaptations should be implemented depending on the specific context where the didactic unit would be carried out. Some of these changes are the following:

- Based on the time limitation, adaptations to the schedule and the program may need to be done throughout the course, especially depending on the rhythm and pace of learning of the specific group class. The teacher will need to rearrange minor aspects in order to meet the time schedule and, thereby, be able to work on each planned didactic unit properly.

- In secondary schools where students do not have access to a personal electronic device such as a computer or an iPad, combining paper-based materials – such as books, articles or other academic resources –with a digital presentation in English by the teacher would be the most effective way to learn the physiology of the human body systems rather than using digital tools such as the BBC bitesize or science bits., so that Furthermore, some secondary schools may not be willing to pay for the body planet resources, as they may prefer to invest their expenditure on other prioritized resources, so that tool proposed in the project should also be eliminated and substituted by 2D models or, if possible, physical 3D models to help students have a more real vision of the human body instead of only watching pictures.

- In order to overcome the likely English knowledge limitations of some students willing to be take part in the CLIL learning methodology, a comfortable and non-judgmental environment should be offered. Furthermore, apart from avoiding focusing on grammar or pronunciation, more flexibility should be given to the approach, by enabling students to combine their mother language with the English language with the aim of progressively immersing in the foreign language until completely mastering it.

- In order to enhance the CLIL approach and increase the number of teachers with a non-linguistic background being open to teach their science classes in English, collaborations within different departments should be encouraged, so that teachers of foreign language can provide support to those implementing the CLIL approach, promoting therefore a more interdisciplinary vision. Furthermore, looking at the big picture, it would be desirable for the education Department to locate more resources and promote teachers training on CLIL approaches, although this would not be an adaptation to be made at the secondary school center itself, but more of a social issue that should be tackled by authorities.
- In order to reduce disparity among students, a CLIL approach were all the students can participate should be encouraged with the proper adaptations, which would include more simple tasks and basic vocabulary for the students with a limited English level with extra tasks to provide the proper educational care to those students with higher level, making sure all the needs are met in the diversity of the classroom. However, this would be quite difficult, especially with only one teacher per class. Thereby, as stated before, if government expenditure on education increased and in the CLIL classes two teachers guided the learning process rather than one, more significant benefits

and positive outcomes would probably be seen in the students' progress. However, as before, this is not an adaptation itself, but more of a general reflection.

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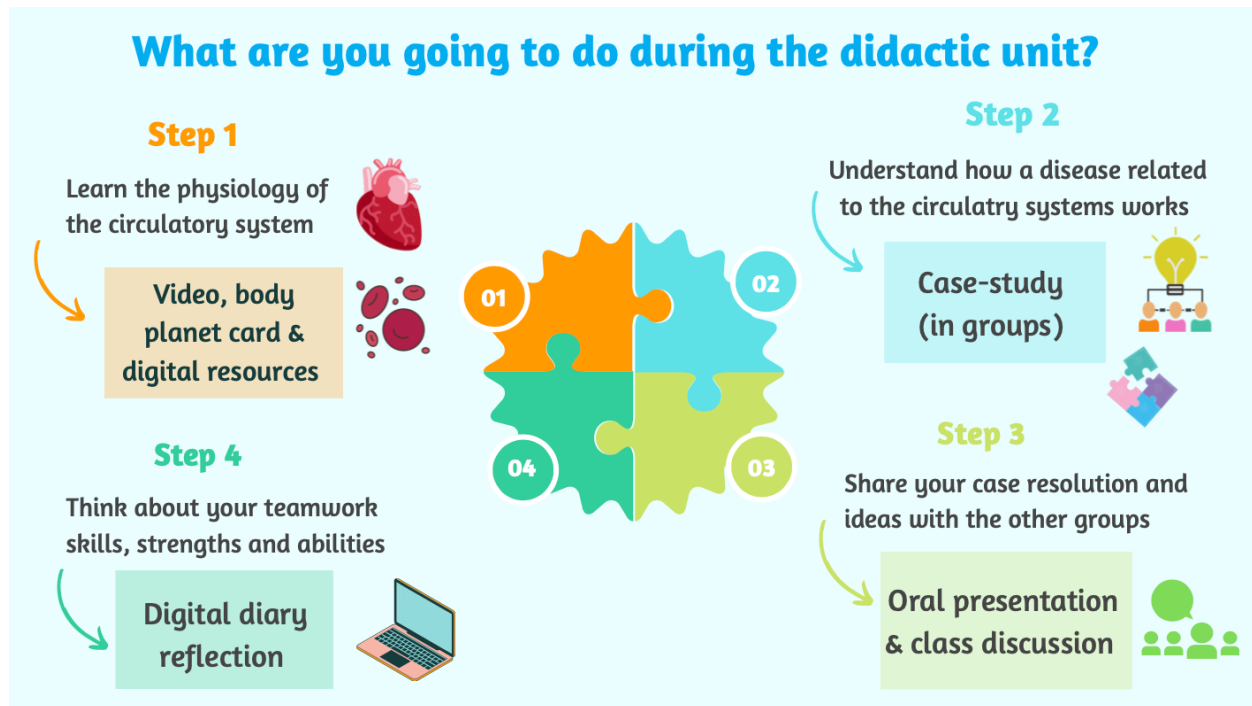
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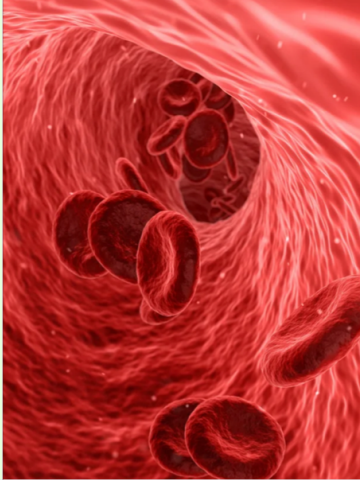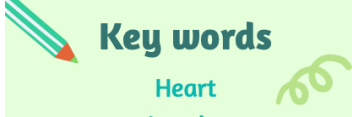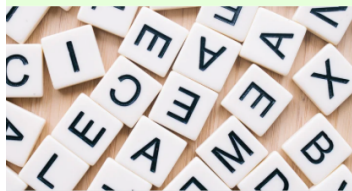
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Annex 1. Leaflet. Syllabus of the Didactic Unit 6: the circulatory system

Which assessment tools will be used?

- Case resolution
- Class activities & tasks
- Presentation assessment rubric (teacher)
- Co-assessment rubric (students' group)
- Self-assessment rubric (students - individually)
- Digital learning diary (students - individually)

What will you learn?

- Objective 1. Which are the basic structures and organs of the system
- Objective 2. How the blood circulates inside our body
- Objective 3. An insight into the characteristics of a disease related to the circulatory system
- Objective 4. How to promote your health and prevent chronic diseases' development

Syllabus

DU6

THE CIRCULATORY SYSTEM

Key words

Heart
Arteries
Veins
Capillaries
Erythrocytes
Leucocytes
Thrombocytes
Oxygen
Carbon dioxide
Disease
Symptoms
Diagnosis
Treatment

Vocabulary

Blood vessels
Blood flow
Chronic disease
Acute disease
Lifestyle habits
Health promotion
Disease prevention
Toxic substance
Long-term consequences
Cardiovascular health
High blood cholesterol
High blood triglycerides
Public health problem

Considerations

Timing: 4 weeks
Groups: 4 persons

Let's keep solving the human body puzzle!

Source: own elaboration

Annex 2. *"What are you going to do during the didactic unit?"* card: a step-by-step of the didactic unit

What are you going to do during the didactic unit?

Step 1

Learn the physiology of the circulatory system

Video, body planet card & digital resources

01

02

Step 2

Understand how a disease related to the circulatry systems works

Case-study (in groups)

Step 3

Share your case resolution and ideas with the other groups

Oral presentation & class discussion

04

03

Step 4

Think about your teamwork skills, strengths and abilities

Digital diary reflection

Source: own elaboration

Annex 3. Digital resources: video, body planet circulatory system cards, Science Bits and BBC Bitesize

• **Circulatory system online video "The heart and circulatory system – how they work"**. Accessible at: https://www.youtube.com/watch?v=CWFyxn0qDEU

• **Body planet app and circulatory system cards**. Accessible at: https://bodyplanet.es

• **Science Bits website**. Accessible at: https://science-bits.es/site/en/

• **BBC Bitesize.** Accessible at:
https://www.bbc.co.uk/bitesize/topics/zvrrd2p/articles/zkq7wnb?course=zng3ydm

• Body planet app and circulatory system cards

Body planet circulatory system card.
Source: https://bodyplanet.es
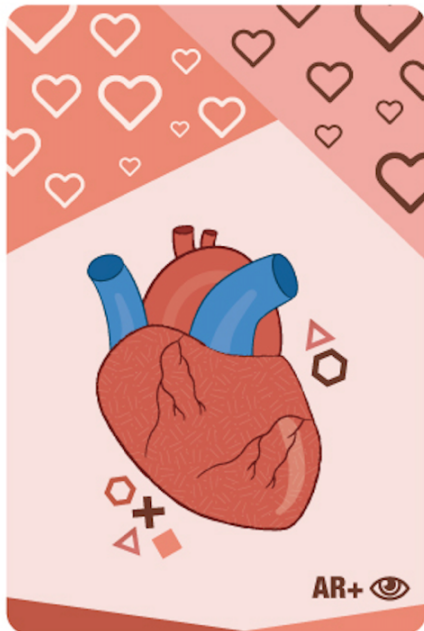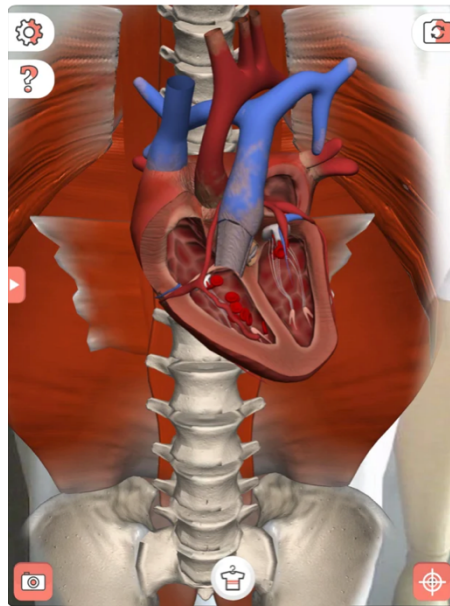
Body planet circulatory system overview.
Source: https://bodyplanet.es

• Science Bits website

Science Bits contents overview.
Source: https://science-bits.es/site/es

Science Bits activities overview.
Source: https://science-bits.es/site/es

• BBC Bitesize

Bitesize

Home | Learn | Support | Careers | My Bitesize | ≡ All Bitesize

Change language ·

KS3

The circulatory system

Part of **Biology** | **Respiration and gas exchange**

+ **Add to My Bitesize**

Jump to

| Key points
Blood vessels
The heart
Double circulatory system
Test your knowledge
Quiz
Test questions

Key points

- There are three types of blood vessel: arteries, veins and capillaries.
- The heart is a muscular organ that pumps blood around your circulatory system.
- The circulatory system is the heart and all the blood vessels in the body which carry cells and substances to all its parts.

Blood vessels – arteries, veins and capillaries

There are three types of blood vessel:

- **Arteries** carry blood away from the heart straight after it has been pumped. This means it is under **high pressure**. The walls of arteries are made of thick muscle to withstand this pressure. This muscle is also elastic to allow a pulse of blood to travel along when your heart beats.

- **Veins** carry blood back to the heart. This blood is under **lower pressure** because some of it has been lost as it travelled around your body. The walls of veins are made of thinner muscle and are less elastic than arteries. Because the blood is under lower pressure, one-way valves in your veins stop it flowing backwards.

- **Capillaries** are the tiny blood vessels that branch out into every tissue in your body carrying substances your cells need like oxygen and glucose for **respiration** and for removing waste products like carbon dioxide. They have very thin walls to allow these substances to move by **diffusion** in and out of your cells. Capillaries join your arteries to your veins.

Body planet circulatory system card. Source: https://bodyplanet.es

The heart

The heart is a large muscular organ which pumps blood to the lungs and then the rest of your body. It has four chambers.

Aorta
Pulmonary artery
Pulmonary vein
Right atrium
Left atrium
Vena cava
Left ventricle
Right ventricle

■ Oxygenated blood
■ Deoxygenated blood
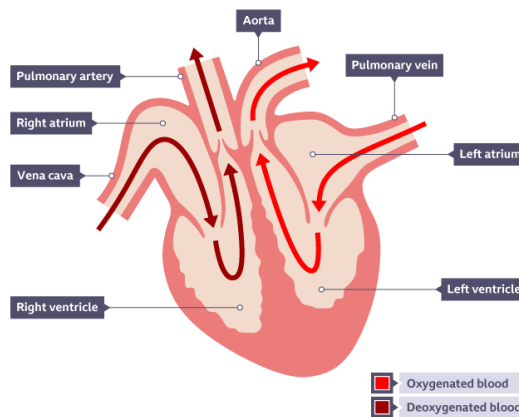
The heart has four chambers and a thick muscular wall

The two top chambers are called **atria** (right atrium and left atrium) and the bottom chambers are called **ventricles** (right ventricle and left ventricle). The atria collect blood and then pump them to the ventricles below. The ventricles then pump the blood to the body. It looks as though the ventricles are bigger but the four chambers inside are the same size. It is the muscular lining of the ventricles that are bigger because they have to pump the blood further than the atria.

BBC Bitesize website overview. Source: https://www.bbc.co.uk/bitesize/

DU6

THE CIRCULATORY SYSTEM CASE-STUDY

• <u>Patient symptoms</u>

Sam is a 45 years-old male who shows up with his 15 year-old son, Mark, at the emergency room (ER) of *Josep Trueta* hospital, which is his reference hospital, as he lives in Bescanó. He explains that he has been feeling bad for 3 hours and now he is feeling worse. He complains of the following **symptoms**:

- <u>Shortness of breath</u>
- <u>Fatigue</u>
- Strong pain and <u>tightness</u> in the chest and left arm

- <u>Shivers and cold sweating</u>
- <u>Sudden dizziness</u>
- <u>Nausea and vomiting</u>

• <u>Tests and laboratory data</u>

At the ER, they do Sam an <u>**electrocardiogram**</u> **(ECG)**, which shows abnormalities in his heart.

They also draw a <u>blood sample</u> and run some tests in order to obtain laboratory data to have extra information to solve the case and determine the disease he suffers. The results show some **alterations**:

- High blood **cholesterol** levels
- High blood **triglyceride** levels

• <u>Diagnosis</u>

The doctor examines him and by combining the symptoms and the ECG he makes a diagnosis. Sam suffers a condition that **affects his heart** and it has happened because the <u>blood flow</u> to his heart has been **blocked**.

The doctor tells the patient that his blood vessels have **atherosclerosis** and this is the cause of the <u>disease</u>. He also explains that atherosclerosis can be prevented by having a **healthy lifestyle and adequate habits**.

• <u>Treatment and consequences</u>

The doctor <u>prescribes</u> Sam a medication called *Aspirin,* and explains that it will help prevent his blood to coagulate too much and avoid the formation of <u>blood clots</u>.

He also tells him that it is very important to **make some changes in his lifestyle habits**.

Mark is scared and asks the doctor is his father Sam will have the disease forever or if it will disappear. The doctor explains them that he will <u>suffer</u> it always and he could have some <u>long-term consequences</u>

He <u>highlights</u> that in order to **prevent the disease from <u>worsening</u>** and to **avoid suffering the pain** he had when he came to the ER, he must take the medication every day and make changes in his life.

• <u>Other relevant information for the case: Sam's lifestyle and habits</u>

When the doctor asks him for his clinical history and lifestyle habits, Sam explains the following:

- **Drinking**: 3-4 beers/daily and additional 4-5 drinks of other types of alcohol during the weekends (rum, gin and tonic, whisky...)
- **Smoking:** one and a half (1.5) packet/day of tobacco (approximately 30 cigarettes)
- **Working**: he works in an office 8 hours/day, where he is sitting most of the time.
- **Stress:** he admits having high levels of stress in his life currently.
- **Sleep:** he only sleeps 4-5 hours/day and sometimes has difficulty falling asleep.
- **Physical activity**: he does not practice any sport and does not do any physical activity. He uses the car to commute to work and uses the elevator to go up to his apartment and other buildings.
- **Eating habits:** he has never been concerned about eating healthy, because he thinks it is not important and it does not have a negative impact on his health.

The doctor asks the patient what he eats on a daily basis and he gives an example of what typical foods in his usual diet:

Breakfast	Mid-morning snack	Lunch	Mid-afternoon snack	Dinner
- Coffee with milk and 3 teaspoons - A donut	- A white-bread sandwich with "fuet" - 1 Coca-Cola drink	- White pasta with bacon and carbonara sauce - Fried chicken with potato chips - 2 beers	- ½ packet of "Prince" biscuits	- A hamburger from McDonalds - 1 beer

🧩 Student names:

Group number:

🧩 Questions to be answered

1. The doctor tells Sam that his major illness is caused by "atherosclerosis":

- What is atherosclerosis? Explain its characteristics and describe the process by which it is formed.

- How long does it take to develop (days, weeks, months, years…)?

- How could Sam have prevented atherosclerosis development? (based on Sam's information regarding lifestyle and habits)

2. The doctor also says that atherosclerosis affects the blood vessels. What types of blood vessels does the human body have? Explain its main characteristics and functions.

Blood vessel	Characteristics	Functions

3. What main disease suffers Sam? How have you reached this conclusion?

4. What is the difference between a chronic and an acute disease? Define their main characteristics.

    • Type of disease Sam suffers:

Chronic diseases	Acute diseases

5. The doctor says this disease damages the heart and the blood vessels. How are the heart and the blood vessels affected?

Affectation of the heart	Affectation of the blood vessels

6. The doctor tells Sam that he could have some long-term consequences. Explain which long-term consequences are related to the disease:

Long-term consequences

7. Is this type of disease preventable to some extent? If so, how could this patient have prevented or slowed down its development?

8. What changes would you recommend this patient to do in his diet to improve his overall cardiovascular health?

9. Sam explains that he does not know what food is healthy and needs advice. Design a one-day menu to help him, based on the previous healthy food recommendations you have provided.

Breakfast	Mid-morning snack	Lunch	Mid-afternoon snack	Dinner

10. What other changes would you highly recommend the patient to do in order to improve his health and prevent his disease from worsening?

11. His blood test shows he has high blood cholesterol and triglyceride. Is this something Sam should be concerned? Why?

🧩 Let's take action: promoting our health and preventing the future development of chronic diseases

1. Apart from the disease you have worked on in the first part of this case, there are many other chronic diseases in our society nowadays. List three of them:
    -
    -
    -

2. Provide three life-style measures to help prevent the development of chronic diseases

    -
    -
    -

3. Explain what a healthy diet is and why it's important for the prevention of chronic diseases

    Healthy diet basic characteristics:
    -
    -
    -
    -

    Importance:

4. Explain to what extent the saturated and *trans* fats from unhealthy foods damage the arteries and the heart. *Hint: relate the circulatory and the digestive system!*

5. Are other toxic substances harmful for the heart and arteries functioning? If so, provide two examples of toxic substances and their damaging process. *Hint: we have already discussed the detrimental effects of some toxic substances in the digestive system*
    • Toxic substance 1:
    - Process by which it damages the circulatory system:

    • Toxic substance 2:
    - Process by which it damages the circulatory system:

🧩 <u>Extra activity:</u> Read the following text adapted from a newspaper article, critically discuss it with your partners and comment on the questions below.

The group that must do their oral presentation will have to complete this extra task.

Spain's Ministry of Consumer Affairs has announced that it will <u>ban</u> <u>advertising</u> for unhealthy foods and drinks that are aimed at children and adolescents via TV, radio, social media, websites, applications, cinemas and newspapers. Products included in the ban include candy made with chocolate or sugar, energy bars, sweet toppings and desserts, cakes, sweet biscuits, cookies and other baked goods, juices, energy drinks and ice creams.

"In Spain, one in every three children is overweight or obese," the Consumer Affairs Ministry stated and "Advertising is one of the causes of this figure". Therefore, banning advertisement of some products is a tool to reduce the "alarming" rates of childhood obesity in Spain, which is a serious <u>public health problem</u>.

The government is <u>aiming</u> to combat the issue of childhood obesity with these measures. According to a <u>study</u> <u>carried out</u> in 2019, which is based on surveys of children aged six to nine, 40.6% of these minors are above their recommended weight, while 23.3% are overweight and 17.3% are obese.

Do a reflection on how the chronic diseases affect our current society. In your answer, comment on the following issues and any other information you consider interesting and relevant to the topic.

- Why do you think there has been an increase in the number of children suffering obesity/overweight?
- Do you think this is a situation to be concerned about?
- Do you consider that limiting advertisement will be an effective measure to reduce obesity rates? What other measures could the government implement to <u>tackle</u> the situation?
- What can citizens themselves do to <u>tackle</u> this situation?

- Why has there been a <u>rise</u> in the number of chronic diseases over the last decades around the world?
- Is it something we should be concerned about?
- What should the authorities (government and health departments) do to <u>tackle</u> this situation?

Group reflection:

🧩 Key vocabulary from the case-study:

Word	Meaning	Translation
shortness of breath	feeling of not getting enough air when you breathe	dificultat per respirar
fatigue	being extremely tired	fatiga, cansament extrem
tightness of the chest	an uncomfortable feeling of pressure in the chest	sensació de tibantor al pit
shivers and cold sweat	shake because you feel ill and produce sweat that feels cold in the skin	calfreds i suor freda
sudden dizziness	feeling that you may fall	mareig sobtat
electrocardiogram	an electronic image that shows the heart beating activity	electrocardiograma: imatge que mostra el batec del cor
blood sample	a small amount of blood drawn from a person's body	mostra de sang obtinguda a partir d'una extracció de sang
disease	the state of being sick because of a specific affection	Malaltia
blood flow	process by which the blood circulates within the body	circulació sanguínia
Lifestyle habits	the way of living and habits of a person	Hàbits de vida
prescribe	give a medical treatment to someone	Receptar una medicació
blood clot	a hard accumulation of blood formed in the blood vessels	coàgul de sang
suffer	experience a disease	patir una malaltia
long-term consequences	consequences that happen and continue for many years in the future	conseqüències a llarg termini
highlight	to emphasize something that is important	fer èmfasi, donar importància
worsen	make something worse, more difficult,	empitjorar

🧩 Key vocabulary from the extra activity:

Word	Meaning	Translation
ban	not allow something, forbid	prohibir
advertising	a tool used to persuade people to buy a product or a service	publicitat
public health problem	a medical condition that affects a significant percentage of the population	problema de salut pública: malaltia que afecta a un percentatge significatiu de la població
aim	to want to achieve a specific result/goal	tenir l'objectiu
carry out a survey	ask some questions to individuals to get responses about a topic	realitzar una enquesta a una mostra de població
tackle	deal with a difficult situation to find a solution	afrontar/solucionar un problema
a rise	an increase / a larger amount	un increment / un major nombre

Source: own elaboration

Annex 5. Useful resources to work on the case study

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USEFUL RESOURCES

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• Cambridge dictionary: https://dictionary.cambridge.org

• Science Bits English version: https://science-bits.com/site/en/

• Body Planet: https://bodyplanet.es

BBC Bitesize – the circulatory system:
https://www.bbc.co.uk/bitesize/topics/zvrrd2p/articles/zkq7wnb?course=zng3ydm

• Mayo clinic – diseases and conditions: https://www.mayoclinic.org/diseases-conditions

• American Heart Association: https://www.heart.org

• Canada's food guide – the food plate: healthy eating resources. https://food-guide.canada.ca/en/healthy-eating-resources/

• *Petits canvis per a menjar millor* (Departament de Salut, Generalitat de Catalunya):
https://canalsalut.gencat.cat/ca/vida-saludable/alimentacio/petits-canvis-per-menjar-millor/

• Nutrition Australia – healthy eating pyramid: https://nutritionaustralia.org/fact-sheets/healthy-eating-pyramid/

• Newspaper article - Spanish government to ban advertising aimed at children of unhealthy foods such as chocolate, juices and ice creams. https://english.elpais.com/society/2021-10-29/spanish-government-to-ban-advertising-aimed-at-children-of-unhealthy-foods-such-as-chocolate-juices-and-ice-creams.html

</div>

Source: own elaboration

. "Do you want to know more about the topic?" card

DO YOU WANT TO KNOW MORE ABOUT THE TOPIC?
BLOOD DONATIONS

Next month the Red Cross is carrying out a blood donation campaign in Bescanó.

Create a digital presentation in the format you find more suitable (video, leaflet, poster…) to be presented in the school entrance and the town hall to expose the basic features of blood donations in order to raise awareness of the importance of blood donation for saving lives.

Some features that would be recommended to be included in the final product are:

- What are blood donations? Which are their basic characteristics?

- Which are the basic characteristics and functions of the different types blood cells? What are the different blood types?

- Why is it crucial to take into account the blood type of the donor and the recipient?

- Why are they important for society?

- Can you provide some diseases and examples where blood donations may be necessary and helpful?

- Which are the requirements to be a blood donor?

- What is and isn't recommended to do right after a blood donation?

- What type of foods should be eaten after the donation?

- How would you raise awareness to increase blood donations in our population?

Some resources you may want to use are listed below:

- Red Cross blood donation website: https://www.donarsangre.org

- Banc de sang i teixits: https://www.bancsang.net/pacients/banc-sang/

- What happens to donate blood? https://www.youtube.com/watch?v=Tfwq_vJHwT8

- Tips after blood donation: https://www.youtube.com/watch?v=NYZBmdT_o8I

Source: own elaboration

Teacher assessment rubric of the students' oral presentation

Names of the students	

Assessment criteria	Expert (4)	Advanced (3)	Apprentice (2)	Novel (1)	Weight
Content (kwnowledge of the scientific topic)	Shows a full understanding and knowledge of the scientific topic and an outstanding resolution of the case-study, with only few minor errors in the answers	Shows a good understanding and knowledge of the scientific topic and a great resolution of the case-study, with only few questions not properly answered	Shows a fair understanding and knowledge of the scientific topic and a fair resolution of the case-study, with some questions not properly answered	Shows a poor understanding and knowledge of the scientific topic and a poor resolution of the case-study, with most of the questions not properly answered	40%
Content (kwnowledge of the topic-related vocabulary)	Shows an excellent use of the topic-related vocabulary and is able to define correctly specific scientific words	Shows a good use of the topic-related vocabulary and is able to define some but not all of the specific scientific words	Shows a fair use of topic-related vocabulary and is able to define only some of the specific scientific words	Shows a poor use of topic-related vocabulary and only uses very basic and limited vocabulary	
Structure (introducing theselves, introducing the topic, development and closing)	Provides an exceptionally well-organized presentation with an introduction, a development and a closing that follow a coherent order and are easy to understand	Provides a good presentation with a concise and clear introduction and a development and a closing that are clear and easy to understand.	Provides a fair presentation with a clear introduction but an unclear development that makes it difficult to understand some of the parts	Provides a poor presentation lacking a clear introduction and with an unclear development that makes it difficult to understand it overall	35%
Creativity and presentation design	The final product is made in an attractive and original way, cathces the audience	The final product is fairly original, is clear to understand and most of the	The final product is clear and easy to understand but lacks originality and some	The final product is poorly attractive and not original and ithe information is	

	attention and all the information presented is clear to understand	information presented is clear to understand	information is presented in an unclear way	presented in an unclear way most of the time	10%
Fluency	Speaks confidently and naturally with ideas flowing smoothly, with only minor hesitations, and without using Catalan/Spanish expressions or words	Speaks naturally with several hesitations but knowing the proper words to use, and without using Catalan/Spanish expressions or words	Speaks in an insecure way, hesitating frecuently, showing problems to communicate some meanings and using some Catalan/Spanish words as well as reading from papers from occasionally	Speaks in an insecure way, hesitating frecuently, showing problems to communicate most of the time and using Catalan/Spanish words often as well as reading from papers most of the time	5%
Grammar	Uses many different structures depending on the context and with few grammatical errors	Uses a variety of structures but makes some minor mistakes	Uses a variety of structures with frquent mistkes or uses basic structures with few grammatical errors	Uses only basic structures and makes frequent and relevant mistakes	5%
Body language	Stands up confidently, looking relaxed and establishes eye contact with the public all the time	Stands up looking quite relaxed, without noticeable nervous expressions and establishes eye contact with the public occasionally	Stands up looking quite nervous, fidgeting and establishes eye contact with the public only a few tims, with most of the time only looking at the teacher or the ground	Stands up with a body language and a facial expression showing no interesst and enthusiasm about the topic	5%

Source: own elaboration

Annex 8. Teacher assessment rubric of the personal and social field

Assessment criteria and assessment indicators of the PS field					
Assessment criteria	Achievement level indicators	Observed frequency			
		Almost never	Sometimes	Often	Very often
Participates in the proposed class activities and debates and cooperates with their colleagues in order to promote self-knowledge and to responsibility for their own personal growth	Performs and completes the assigned tasks in a responsible manner				
	Shares their ideas and opinions with their colleagues and teacher				
	Listens to the other students and respects their time to take the turn in the class debates				
	Respects others' opinions and suggestions				
	Shows a critical attitude towards analyzing aspects related to their own daily life and their close surroundings				
	Justifies and reasons their actions in the participative learning activities				
	Demonstrates an enthusiastic attitude towards learning and personal growth				

Source: own elaboration

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Annex 9. Students' co-assessment rubric of the other students' groups oral expositions

Names of the students assessing	
Names of the students presentating the case	

Assessment criteria	Expert (4)	Advanced (3)	Apprentice (2)	Novel (1)
Content (scientific topic)	The group shows a total understanding and knowledge of the scientific topic and a complete resolution of the case-study, with only few minor errors in the answers	The group shows a good understanding and knowledge of the scientific topic and a good resolution of the case-study, with only few questions not properly answered	The group shows a fair understanding and knowledge of the scientific topic and a fair resolution of the case-study,with some questions not properly answered	The group shows a poor understanding and knowledge of the scientific topic and a poor resolution of the case-study, with most of the questions not properly answered
Content (topic-related vocabulary)	The group uses all the topic-related vocabulary worked in class and is able to define specific scientific words when asked	The group uses some of the topic-related vocabulary worked in class and is able to define some but not all the specific scientific words when asked	The group uses only a few of the topic-related vocabulary worked in class and is able to define only a few specific scientific words when asked	The group does not use and only uses basic vocabulary and is unable to define any specific scientific words when asked
Structure	The structure of the presentation is well-organized and extremeley easy to follow, the group does a great introduction and conclusion	The structure of the presentation is well-organized and quite easy to follow, with a fair introduction and conclusion	The structure of the presentation is generally clear , with a brief introduction and conclusion, but some parts are difficult to follow	The structure of the presentation is unclear and the group does not provide an introduction nor conclusion, and it is difficult to follow most of the time
Creativity and presentation design	The presentation is really attractive and original, uses different resources, catches the attention and all the information is clear and easy to understand	The presentation quite original but does not use different resources, all the information is clear and easy to understand	The presentation is not really original and some information is unclear and not easy to undersand	The presentation is not attractive at all and almost all the information is unclear and not easy to undersand

Source: own elaboration

Annex 10. Students' self-assessment rubric of their own work and participation within their group

Student name	

Assessment criteria	Expert (4)	Advanced (3)	Apprentice (2)	Novel (1)
Participation	Participates actively and constantly in the group, providing ideas and organizing the tasks to be done all the time	Participates actively and in the group, providing ideas and organizing some tasks to be done	Participates only sometimes and providing some ideas but has difficulties in organizing the tasks	Participates only few times and the ideas provided are not especially useful for the tasks
Attitude for learning	Demonstrates an enthusiastic attitude towards learning and personal growth all the time	Demonstrates a positive attitude towards learning and personal growth most of the time	Demonstrates a good attitude towards learning and personal growth, but sometimes shows no interest	Demonstrates no interest towards learning and personal growth most of the time
Group discussion	Shares their ideas and opinions with their colleagues and listens and respects others' opinions and suggestions all the time	Shares their ideas and opinions with their colleagues and listens and respects others' opinions and suggestions most of the time	Shares their ideas and opinions with their colleagues only sometimes and listens and respects others' opinions and suggestions only sometimes	Has difficulties sharing their ideas and opinions with their colleagues only sometimes and usually doesn't respect others' opinions and suggestions
Collaboration	Shows an open attitude towards working in a group and collaborating with their peers all the time	Shows an open attitude towards working in a group and collaborating with their peers most of the time	Shows an fair attitude towards working in a group and collaborating but sometimes is not eager to cooperate	Shows an negative attitude towards working in a group and collaborating all the time
Conflict resolution	When conflicts arise, shows a respectful attitude and effectively communicates with others to solve them	When conflicts arise, shows a respectful attitude and communicates with others to solve them most of the time	When conflicts arise, shows a respectful attitude but finds it difficult to communicate with others to solve them	When conflicts arise, does not showsa respectful attitude and does not communicate with others to solve them
Tasks completion	Performs and completes the assigned tasks in a responsible manner and on the time scheduled within the group	Performs and completes the assigned tasks in a responsible manner and on the time scheduled within the group	Performs and completes the assigned tasks in a fair manner but sometimes does it later than scheduled	Performs and completes the assigned tasks in a poor manner and most of the time does it later than scheduled

Source: own elaboration

Annex 11. Questions to be answered by the students in their digital learning self-knowledge diary

• Regarding my skills, strengths and weaknesses:

- Which are my **strengths** when I participate and work in a group?
- Which are my **weaknesses** when I participate and work in a group?
- What can I do to **convert** these **weaknesses into strengths**?
- Which changes do I need to make to **improve my teamwork skills**?

• Regarding my learning process

- **What** have I learned?
- **How** have I learned it?
- What has been **new** for me?
- What **challenges** did I find? How did I **overcome** them? What could I have **done differently** to overcome them?
- How will this acquired earning be **helpful for me** in the **future**?

Source: own elaboration

My internal weaknesses (cognitive/from my personality)	My internal strengths (cognitive/from my personality)
My external weaknesses (difficulties that don't depend on myself)	My external strengths (situations that help me improve personally)

Briefly explain how you can convert some of your weaknesses into strengths in the future	
Weakness	Strength
→	
On a scale of 1 to 4, how satisfied are with your participation and implication within your group?	
1 2 3 4	

Source: own elaboration

Annex 12. Detailed didactic sequence and teaching-learning activities

WEEK 1							
	Teaching-learning activities						
Session 1	• **What do we know about the circulatory system? Group discussion + Introduction to the main characteristics** - Hand in a leaflet with the syllabus of the DU (includes the objectives, assessment tools, key words, related vocabulary and other considerations) to help students regulate their learning process - Hand in a card "*What are you going to do during the didactic unit?*" (steps of the DU development) - Exploration of previous ideas and misconceptions: presentation of initial questions, brainstorming and group discussion - Assign the case-study oral presentation to a specific group of students so that they can plan ahead their presentation for the session number 7 - Visualize a video of the circulatory system about the basic characteristics of the heart and the blood circulation - Read all together the circulatory system section (BBC Bitesize) regarding its characteristics, organs, structures, functions and importance. Class discussion about the concepts. - In groups, use the Body Planet cards to understand and see it from a real-life 3D view.						

Stages of the teaching-learning process	Competences involved	Students' distribution	Specific materials and didactic resources	Universal and additional educational care measures	Assessment: type and tools used	Timing
- Exploration (initial activity) - Introduction of new contents and structuring the knowledge (development activity)	-ST field: competence 5 -Linguistic field: competence 4, 6 -PS field: competence 1, 4 -D field: competence 4	- Class group (in a circle) -Groups of 3-4 students	- Computer /iPad and projector - Leaflet (syllabus of the DU) - Card "*What are you going to do during the didactic unit?*" - A heart-shaped small toy (give the turn of words in the debate) - Digital resources: Youtube, BBC Bitesize, Body Planet app -Body Planet cards - Digital *Classroom* space	-Consultation to the teacher -Multilevel activities	Initial assessment: the teacher will assess the active participation of the students (sharing ideas, opinions and possible misconceptions, brainstorming), their implication in the discussion and participation in the activities proposed by using the PS rubric that the teacher	1h

			-Internet		will fill in based on the participation observed.	

	Teaching-learning activities
Session 2	• Session 2. Circulatory system physiology: organs, structures, functions and importance - Read together (group class) the circulatory system contents from Science Bits: continue to learn the characteristics, organs, structures, functions and importance of the circulatory system. Class discussion about the concepts. - Individually, students will autonomously work on the completion of the Science Bits activities related to the circulatory system, which they can self-correct to regulate their process of learning. Also, do the quiz of the BBC Bitesize of the circulatory system section.

Stages of the teaching-learning process	Competences involved	Students' distribution	Specific materials and didactic resources	Universal and additional educational care measures	Assessment: type and tools used	Timing
- Introduction of new contents and structuring the knowledge (development activity)	-ST field: competence 5 -Linguistic field: competence 4, 6 -PS field: competence 1, 4 -D field: competence 4	- Class group (in a circle) - Individual	- Computer /iPad and projector - Body planet circulatory cards - Body planet app - Digital resources and contents: Science Bits and BBC bitesize - Digital *Classroom* space -Internet - A heart-shaped small toy (give the turn of words in the debate) - Digital resources: Science Bits - Digital *Classroom* space -Internet	- Consultation to the teacher -Multilevel activities -Peer help	**Formative assessment:** based on the activities completed by the students in the Science Bits app, as the teacher gets immediate feedback of their work and responses. The class participation will also be considered with the PS rubric. .	1h

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WEEK 2						
	Teaching-learning activities					
Session 3	• Session 3. Circulatory system summary task + case-study introduction - Task completion: a concept map or a similar material summarizing the most relevant concepts learned about the circulatory system. They are free to use the digital resource that they prefer to elaborate it. - Introduction to the case-study: students will be asked to gather in their groups and will be handed in the case-study worksheet. It will be read aloud and every section will be explained, so that students can ask for clarification of any part that may seem difficult or unclear. Students will be asked to brainstorm, organize themselves and distribute the different tasks to do among the different members of the group					
Stages of the teaching-learning process	Competences involved	Students' distribution	Specific materials and didactic resources	Universal and additional educational care measures	Assessment: type and tools used	Timing
- Introduction of new contents and structuring the knowledge (development activity)	-ST field: competence 5, 12, 13, 14 -Linguistic field: competence 4, 6, 7 -PS field: competence 1, 2, 4 -D field: competence 2, 4, 8	- Class group - Groups of 3-4 students	- Computer /iPad and projector - Body planet circulatory cards - Body planet app - Digital resources for the concept map (word, power point, Canva…) - Digital *Classroom* space -Internet - Case-study worksheet - Useful resources worksheet	- Consultation to the teacher -Multilevel activities -Peer help	**Formative assessment:** based on the summary task handed in through the *Classroom* space. Class participation and group involvement will also be considered.	1h

Teaching-learning activities					
Session 4	• Session 4. Case-study group resolution - The groups of students will work autonomously on the case-study. The teacher will guide them and help them for any doubts they may have.				
Stages of the teaching-learning process	Competences involved	Students' distribution	Specific materials and didactic resources	Universal and additional educational care measures	Assessment: type and tools used	Timing
- Introduction of new contents and structuring the knowledge (development activity)	-ST field: competence 5, 12, 13, 14 -Linguistic field: competence 2, 4, 6, 7 -PS field: competence 1, 2, 4 -D field: competence 2, 4, 8	- Groups of 3-4 students	- Computer /iPad and projector - Case-study worksheet - Useful resources worksheet - Digital resources (websites, videos, dictionaries…) -Internet - Teacher PS rubric	- Consultation to the teacher -Peer help	**Formative assessment:** based on the personal-social field rubric of the teacher	1h

WEEK 3						
	Teaching-learning activities					
Session 5	• Session 5. Case-study group resolution - The groups of students will continue to work autonomously on the case-study. The teacher will guide them and help them for any doubts they may have.					
Stages of the teaching-learning process	Competences involved	Students' distribution	Specific materials and didactic resources	Universal and additional educational care measures	Assessment: type and tools used	Timing
- Introduction of new contents and structuring the knowledge (development activity)	-ST field: competence 5, 12, 13, 14 -Linguistic field: competence 2, 4, 6, 7 -PS field: competence 1, 2, 4 -D field: competence 2, 4, 8	- Groups of 3-4 students	- Computer /iPad and projector - Case-study worksheet - Useful resources worksheet - Digital resources (websites, videos, dictionaries…) -Internet - Teacher PS rubric	- Consultation to the teacher -Peer help	**Formative assessment:** based on the personal-social field rubric of the teacher	1h

	Teaching-learning activities					
Session 6	• Session 6. Case-study group resolution - The groups of students will continue to work autonomously on the case-study. The teacher will guide them and help them for any doubts they may have and make sure their resolution is almost finished in order to discuss it in the next sessions (7 and 8)					
Stages of the teaching-learning process	Competences involved	Students' distribution	Specific materials and didactic resources	Universal and additional educational care measures	Assessment: type and tools used	Timing
- Introduction of new contents and structuring the knowledge (development activity)	-ST field: competence 5, 12, 13, 14 -Linguistic field: competence 2, 4, 6, 7 -PS field: competence 1, 2, 4 -D field: competence 2, 4, 8	- Groups of 3-4 students	- Computer /iPad and projector - Case-study worksheet - Useful resources worksheet - Digital resources (websites, videos, dictionaries…) -Internet - Teacher PS rubric	- Consultation to the teacher -Peer help	**Formative assessment:** based on the personal-social field rubric of the teacher	1h

WEEK 4						
	Teaching-learning activities					
Session 7	• Session 7. Case-study oral presentation and extra task oral presentation + class discussion - The assigned group makes the oral presentation with the circulatory system case-study resolution answering to all the questions. - The assigned group explains to the other groups the extra activity and shares the group reflection and opinions toward the topic. - A class discussion around the topic (high prevalence and incidence of chronic diseases in the current society) takes places, with all the groups invited to participate and share their thoughts					
Stages of the teaching-learning process	Competences involved	Students' distribution	Specific materials and didactic resources	Universal and additional educational care measures	Assessment: type and tools used	Timing
- Structuring the knowledge (development activity) - Applying the knowledge (synthesis)	-ST field: competence 5, 12, 13, 14 -Linguistic field: competence 2, 7 -PS field: competence 1, 2, 4 -D field: competence 2, 4, 8	- Groups of 3-4 students - Class group	- Computer /iPad and projector - Students digital final product (power point, leaflet, diptych, card, video…) - digital tools (power point, Canva, video editing programs and others) -Internet - Teacher assessment rubric - Students' co-assessment rubric - A heart-shaped small toy (to give the turn of words in the discussion)	- Consultation to the teacher -Peer help	**Formative assessment:** -Based on the oral presentation assessment rubrics of the teacher and the co-assessment rubrics of the students - Based on the personal-social field rubric of the teacher	1h

Teaching-learning activities						
Session 8	• Session 8. Case-study class discussion + self-assessment rubric + learning diary questionnaire - There will be a class discussion of the case-study resolution and all the questions related and comments on the group oral presentation of session 7 - Students will fill the self-assessment rubrics of heir own work and participation within their group - Students will do an individual reflection on their work within the team, their abilities, strengths and weaknesses in their digital learning self-knowledge diary					
Stages of the teaching-learning process	Competences involved	Students' distribution	Specific materials and didactic resources	Universal and additional educational care measures	Assessment: type and tools used	Timing
- Applying the knowledge (synthesis)	-ST field: competence 5, 12, 13, 14 -Linguistic field: competence 7 -PS field: competence 1, 2, 4 -D field: competence 2, 4, 8	- Groups of 3-4 students - Class group (in a cercle) - Individually	- Computer /iPad and projector - Case-study worksheet - Useful resources worksheet - Digital *Classrom* space - A heart-shaped small toy (to give the turn of words in the discussion) - Students' self-assessment rubric - Digital learning self-knowledge diary guieline of questions to be answered -Internet	- Consultation to the teacher -Peer help	**Formative assessment:** based on the students' participation in the class discussion, on the self-assessment rubric and on the personal reflection in the digital learning diary and on the case-study written task handed in by the groups	1h
Total time spent in the DU						8h

Didactic units *(DU)* and curricular contents		
1st trimestre	2nd trimestre	3rd trimestre
"How are the cells organized in our body? In biological systems! Let's solve the puzzle and discover their functions and interrelation"		
Introductory didactic unit *DU1. Human body organization: What is a cell? Let's meet this tinny structure of our body!* - General organization of the human body: relationship between the systems, organs, tissues and cells. - Physical and chemical stimuli and the human body response. Cellular receptors characteristics and the sensory organs. Relationship function *DU2. The endocrine system: do we know the importance of hormones?* - Endocrine system as the effector of the body's responses. Hormonal balance and the most frequent imbalances. Hormones as substances that activate or inhibit specific functions. *DU3. The nervous system* - The nervous system. The neurones, the nervous centres and the nerves. The organs that	Nutrition function *DU5. The digestive system* - Organs and systems that provide nutrients and eliminate waste from the cells: the digestive system. - Food intake as a process to obtain matter and energy. Food digestion and assimilation of nutrients from the external environment to the internal one. - Exchange of matter and energy within the cell and its relationship with the cellular functions and the molecules synthesis *DU6. The circulatory system* ✳ - Organs and systems that provide nutrients and eliminate waste from the cells: the circulatory system. - Exchange of matter and energy within the cell and its relationship with the cellular functions and the molecules synthesis	Reproduction function *DU9. The reproductive system: one plus one equals three!* - The reproduction as the process of transferring the genetic material. Reproductive cells as the transmission vehicle of de hereditary characters and its relationship with the biological cycle. - Male and female genitals and gamets. The reproductive process. Birth control techniques and assisted reproduction techniques. - Physical and psychical changes during adolescence. Diversity of genre. Sexually transmited diseases. Sexual human response. Sexual health and hygiene. *DU10. The immune system: never sleeps, always awake to protect our body!* - The immune system as the effector in response to unknown substances. Hygiene. Active and passive

coordinate the different responses in the body. Factors that affect mental health.	DU7. *The respiratory system*	immunity. Vaccination, allergies and organ transplants.
DU4. *The musculoskeletal system*	– Organs and systems that provide nutrients and eliminate waste from the cells: the respiratory system.	Final didactic unit
- The musculoskeletal system as the efeçfector of body responses. Relationship between morfoanatomy and movement. Stimul that trigger motor responses. Prevention of the most frequent injuries.	- Cellular breathing as a process for oxidazing nutrients in order to transfer energy to the cell	**DU11. *Let's solve the puzzle and bring all the pieces together!***
	DU8. *The excretory system*	Global and holistic view of the interrelationship between the different systems and diseases studied over the year. Final project.
	– Organs and systems that provide nutrients and eliminate waste from the cells: the excretory system.	

✱   The Didactic Unit 6 is the one that is developed in a detailed manner in this project.

Timing	35 weeks with 2 hours of Biology class/week, with a total amount of 70 sessions/scholar year Approximately 12 weeks/trimester, with a total amount of 24 sessions /trimester	
1st trimestre	2nd trimestre	3rd trimestre
DU1. *Human body organization*: 2 weeks (4 hours) DU2. *The endocrine system*: 4 weeks (6 hours) DU3. *The nervous system*: 3 weeks (6 hours) DU4. *The musculoskeletal system*: 3 weeks (6 hours)	DU5. *The digestive system*: 4 weeks (8 hours) DU6. *The circulatory system*: 4 weeks (8 hours) DU7. *The respiratory system*: 2 weeks (4 hours) DU8. *The excretory system*: 2 weeks (4 hours)	DU9. *The reproductive system*: 6 weeks (12 hours) DU10. *The immune system:* 3 weeks (6 hours) DU11. Let's solve the puzzle and bring all the pieces together: 3 weeks (6 hours)