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OUTER SPACE THROUGH THE GRAPHIC NOVEL *DUNE*: A
CLIL Didactic Proposal for Secondary Education

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Table of Contents

Resumen.....	1
Abstract.....	1
1. Introduction.....	2
<i>1.1. Justification.....</i>	<i>2</i>
<i>1.2. The PROMISED project.....</i>	<i>3</i>
<i>1.3. Objectives.....</i>	<i>5</i>
1.3.1. General Objectives.....	5
1.3.2. Specific Objectives.....	6
2. Theoretical Framework.....	6
<i>2.1. CLIL.....</i>	<i>6</i>
<i>2.2. Legislative framework.....</i>	<i>8</i>
2.2.1. Common European Framework of Reference for Languages.....	8
2.2.2. LOMLOE.....	10
2.2.3. Education for Sustainability, Climate Awareness, and SDG.....	13
<i>2.3. STEAM.....</i>	<i>14</i>
<i>2.4. Active Methodologies in EFL.....</i>	<i>16</i>
2.4.1. Project-Based Learning.....	16
2.4.2. Gamification.....	17
2.4.3. ICTs in the educational field.....	19
2.4.4. Integrative Models and Biology.....	21
2.4.5. Storytelling through the use of comics.....	24
3. Proposal of didactical unit.....	25
<i>3.1. Dune.....</i>	<i>25</i>
<i>3.2. Objectives.....</i>	<i>26</i>
<i>3.3. Sessions.....</i>	<i>29</i>
3.3.1. English Sessions.....	29
3.3.2. Biology Sessions.....	38
<i>3.4. Methodology.....</i>	<i>39</i>

4. Results.....	40
4.1. <i>Observations in the classroom.....</i>	40
4.2. <i>Evaluation.....</i>	42
5. Conclusions.....	45
5.1. <i>Analysis and Challenges of the Project.....</i>	45
5.2. <i>Proposals for improvement.....</i>	47
5.3. <i>Final reflection.....</i>	48
6. References.....	49
<i>Web applications.....</i>	52
7. Annexes.....	53
7.1. <i>ANNEX I: Sostenibilización curricular.....</i>	53
7.2. <i>ANNEX II: Evaluation.....</i>	55
7.3. <i>ANNEX III: CANVA SLIDES.....</i>	57
7.4. <i>ANNEX IV: GRAPHIC NOVEL VIGNETTES.....</i>	62
7.5. <i>ANNEX V: CLASSROOM WORK.....</i>	78
7.6. <i>ANNEX VI: WEBPAGES.....</i>	84
7.7. <i>ANNEX VII: ASSESSMENT SLIDES.....</i>	85

Resumen

Este escenario de aprendizaje, desarrollado en el marco del proyecto PROMISED para el alumnado de cuarto de la ESO, integra la asignatura de Inglés y biología mediante un enfoque de aprendizaje basado en proyectos, inspirado en la novela gráfica *Dune*. El alumnado explora los planetas, los entornos espaciales y la sostenibilidad, al tiempo que mejora sus habilidades de comunicación en inglés.

A través de misiones colaborativas, retos de supervivencia, actividades en Padlet y una sala de escape, el alumnado analiza cuestiones medioambientales como la escasez de agua y el cambio climático, vinculando la ciencia ficción con los Objetivos de Desarrollo Sostenible (ODS). Los objetivos lingüísticos incluyen el uso del discurso indirecto y los pronombres relativos en contextos significativos.

La tarea final consiste en diseñar y presentar un planeta sostenible, fomentando el razonamiento científico, la creatividad, la conciencia medioambiental y el pensamiento crítico sobre la relación de la humanidad con los recursos planetarios.

Palabras clave: concienciación climática, pensamiento crítico, sostenibilidad, ciencia ficción y Aprendizaje Basado en Proyectos (ABP)

Abstract

This learning scenario, developed as part of the PROMISED project for fourth ESO students, integrates English and biology through a project-based learning approach inspired by the graphic novel *Dune*. Students explore planets, space environments, and sustainability while improving their English communication skills.

Through collaborative missions, survival challenges, Padlet activities, and an escape room, students analyse environmental issues such as water scarcity and climate change, linking science fiction to the Sustainable Development Goals (SDGs). The language objectives include the use of reported speech and relative pronouns in meaningful contexts.

The final assignment involves designing and presenting a sustainable planet, fostering scientific reasoning, creativity, environmental awareness, and critical thinking about humanity's relationship with planetary resources.

Keywords: climate awareness, critical thinking, sustainability, science fiction and Project-Based Learning (PBL)

1. Introduction

1.1. Justification

This interdisciplinary project, focused on the Promised Erasmus+ project for fourth year ESO students, aims to integrate English language learning with scientific content in biology through a meaningful educational experience and a Project-Based Learning (PBL) approach, inspired by the narrative of the graphic novel *Dune*. The proposal combines science education, language learning and environmental awareness by exploring planets, space ecosystems and sustainability challenges connected to the Sustainable Development Goals (SDGs).

Current education, aligned with the principles of the LOMLOE (2020), promotes a competency-based model that positions students as active protagonists of their learning, fostering the acquisition of knowledge through real, contextualised, and socially relevant situations. In this sense, the project addresses the need to tackle contemporary challenges, such as climate change, scarcity of natural resources, and environmental sustainability from an interdisciplinary perspective.

Factors of personality and motivation may influence students' learning and performance in academic contexts. There is a vast body of research on different motivational constructs that may enhance or diminish learning (Meyerhoffer & Dreesmann, 2019, p. 1367). Therefore, the use of the narrative universe of *Dune* allows us not only to address issues through science fiction but also to motivate students. The planet Arrakis¹ provides an ideal setting for analysing issues such as water scarcity, the adaptation of living beings to their environment, the relationship between natural resources and social organisation, and the environmental consequences of human decisions.

Through a gamified narrative in which students take on the role of scientists in the PROMISED project, emotional engagement, motivation, and meaningful learning are

¹ It is a fictional planet in the graphic novel *Dune*. The conditions on this planet are really extreme, as water is scarce. This planet is similar to Mars.

fostered. Students not only acquire scientific and linguistic knowledge but also develop critical thinking skills, eco-social awareness, and the ability to propose sustainable solutions.

Furthermore, the project addresses the growing need to integrate active methodologies, scientific literacy, and communicative competence in English, fostering the transfer of learning to real-world contexts. Through sequential sessions, including introductory scientific exploration, character-based role-play, survival stations, Padlet missions and an immersive escape room, students develop communicative competence in English while applying biological knowledge about habitability, adaptations and resource management.

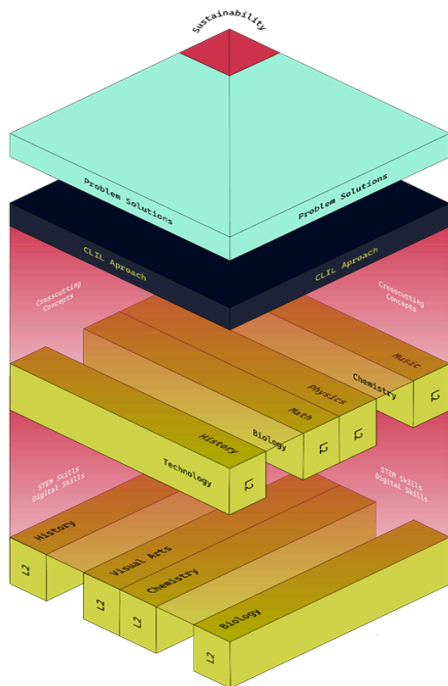
The final product involves designing and presenting a habitable planet or improving an existing solar system planet, inspired by Arrakis, which encourages critical reflection on climate change, ecological responsibility and the influence of science fiction as a tool for environmental awareness. This constitutes an original task that connects academic knowledge with global challenges linked to the Sustainable Development Goals.

1.2. The PROMISED project

PROMISED stands for Promoting Twin Transition via Integrated Steam in Bilingual Secondary Education. The goal of this project is to develop a didactic model that integrates STEAM education—science, technology, engineering, arts, mathematics, humanities, and ecological awareness—in a second language (Promised, 2024, p. 6). Through innovation, creativity, critical thinking, effective communication, teamwork, and knowledge in a multilingual and multicultural society, the goal is to equip students to address critical global issues. With partners from Slovakia (UMB), Belgium (Howest), and Spain (UBU, UGR, CFIE & Kveloce), the Erasmus+ project seeks to create and execute a novel and creative didactic model of effective, integrated, and inclusive STEAM teaching in bilingual secondary education contexts, promoting the double digital and green transition (Promised, 2024, p. 6). Since environmental problems and rapid technological advancements are two of the biggest challenges of the twenty-first century, this dual transition—ecological and digital—in secondary school is crucial for educating children to address these challenges.

Figure 1

PROMISED



Note: Graphic taken from PROMISED

Additionally, by promoting ecological awareness and digital transition, this project encourages the growth of critical and systemic thinking, as well as creativity and innovation to address global issues (e.g., developing technological solutions that promote sustainability, such as renewable energy, waste management, and sustainable agriculture) (Promised, 2024, p. 6). Due to the direct effects of their choices on the environment, this also promotes social and environmental responsibility, cultivates responsible global citizens, and helps close the digital divide by facilitating the efficient and critical use of information to improve access to it (Promised, 2024, p. 6). Therefore, these two areas, digital and green transition, are essential cornerstones for addressing upcoming issues, training youth for a constantly evolving economy, and creating a more just, equitable, and sustainable world. Here, the goal is to foster a genuine learning environment that is similar to the actual world, where several fields of knowledge are frequently combined (Promised, 2024, p. 6). Three outcomes are anticipated. First, a pedagogical framework that explains in detail how the STEAM + CLIL integrative didactic approach was developed and implemented in secondary schools throughout Europe. With remarks on technique and a comprehensive teaching plan, this pedagogical framework will serve as the foundation for four integrated STEAM bilingual classes that are centred on developing the abilities required for the twin transfer (Promised, 2024, p. 6). To successfully implement integrated STEAM proposals in multilingual settings, the project will also include detailed instructions for secondary school teachers, pre-service teachers, and stakeholders.

Keeping in mind that the entire teaching-learning process will take place in the L2, the PROMISED model gradually transitions from a more “disciplinary” approach to a more “interdisciplinary” one (Promised, 2024, p. 28).

1.3. Objectives

1.3.1. General Objectives

The purpose of this project is to promote interdisciplinary learning that integrates scientific knowledge, English language communication skills, and eco-social awareness through an educational experience based on scientific storytelling and the resolution of global problems.

To this end, the topics of planets and space from the biology curriculum will be integrated through the graphic novel *Dune*. All of this will be approached through cross-curricular themes to understand and address students’ interests. To achieve this, it is essential that students actively participate in their teaching-learning process, contributing to the critical perspective that this project proposes. With all of this, a framework will be established with the following objectives:

- To understand the relationship between planetary conditions and the possibility of life. Moreover, analyse factors such as climate, water availability, and the adaptation of living beings.
- To develop communicative competence in English by using the language as a tool to research, debate, and communicate scientific knowledge.
- Foster critical thinking through the analysis of environmental and social issues present in science fiction and their connection to current reality.
- Promote environmental awareness and civic responsibility, while understanding the current challenges of climate change and relating them to the Sustainable Development Goals.
- Apply active methodologies based on cooperation, research, and creativity to solve global challenges.
- Integrate the use of digital tools as a means of communication, reflection, and collaborative creation.

- Develop autonomy, personal initiative, and responsible decision-making in simulated scientific research contexts.

1.3.2. Specific Objectives

The specific objectives will be developed throughout the learning proposal that has been carried out, which is part of the English course for 4th-year ESO students in bilingual programs.

To establish the specific objectives, the Real Decreto 217/2022 has been used as a reference, which sets forth the structure and minimum curriculum requirements for Compulsory Secondary Education.

Students should be able to:

- Understand the conditions necessary for the habitability of planets based on scientific evidence.
- Analyse the relationship between climate, extreme ecosystems, and the adaptations of living organisms.
- Adopt responsible habits toward the environment and sustainable development.
- Relate the narrative of *Dune* to the SDGs.
- Propose sustainable solutions applicable to real-world contexts.
- Develop creativity through the narrative and scientific reinterpretation of the studied graphic novel.
- Communicate scientific ideas orally and visually.

In the proposal of the didactical unit, these objectives would be developed.

2. Theoretical Framework

2.1. CLIL

According to Coyle (2007), the European Network of Administrators, Researchers, and Practitioners (EUROCLIC) adopted the general name CLIL (Content and Language

Integrated Learning) in the mid-1990s. It includes all activities where “a foreign language is used as a tool in the learning of a non-language subject in which both language and the subject have a joint role” (Coyle, 2007, p. 545). Adopting a “label” was, in fact, a crucial step in positioning CLIL alongside bilingual education, content-based instruction, immersion, and other approaches, as well as in promoting additional thought and development (Coyle, 2007, p. 545).

In CLIL, learning a foreign language is an integral component of the entire learning process, rather than the explicit goal of education. European CLIL programs offer a variety of objectives related to culture, environment, language, content, and/or learning due to their diversity (Jäppinen, 2005, p. 149). This demonstrates that while language is usually a crucial component of a CLIL learning environment, language instruction or learning is frequently not the primary focus of CLIL programs (Jäppinen, 2005, p. 149). Moreover, CLIL encompasses not just the mandatory schooling sector but also kindergarten, vocational, and professional learning, regardless of language, age, or stage. It embodies lifelong learning. In this way, the location of CLIL models on the continuum is determined by situational and contextual factors (Jäppinen, 2005, p. 149).

Proficiency in both the language being taught and the non-language subject is to be cultivated through CLIL, with equal weight given to each (Lasagabaster, 2011, p. 6). The following are the goals of the CLIL provision: to provide students with better employment opportunities in the labour market and to prepare them for life in a more globalised society (socioeconomic aims). Using the CLIL target language, teach students the ideals of respect and tolerance for various cultures (sociocultural objectives). To motivate students to learn languages by using them for actual practical applications (linguistic aims) and to help students build language abilities that emphasise successful communication (Lasagabaster, 2011, p. 7).

By encouraging “you can do it!” foreign language exercises, CLIL supports science, literature, and history classes. It necessitates that teachers have a thorough understanding of both the primary theories of foreign language acquisition and the developmental stages of language learning (Barre-Parrales & Villafuerte-Holguín, 2021, p. 100). Academics must comprehend certain aspects of CLIL, particularly the distinctions between studying a mother tongue and a foreign language (Barre-Parrales & Villafuerte-Holguín, 2021, p. 100). Coyle (2007) developed what she termed the 4Cs conceptual framework, adopting a holistic perspective. It emphasises the connections between: content, which successfully places the

acquisition of knowledge, skills, and understanding inherent in that discipline; communication, which defines language as a conduit for communication and learning; cognition, which represents a cognitive challenge for students to improve their thinking and basic interpersonal communication skills and the cognitive-academic language competence; and culture, which serves to encompass multiculturalism given the close relationship between language, thought, and culture (Barre-Parrales & Villafuerte-Holguín, 2021, p. 100). The fundamental concept was to integrate various aspects of CLIL to develop CLIL pedagogies and, consequently, to promote research into its various sides.

Additionally, in today's technologically advanced and global culture, it is crucial to realise that learning a second language enables students to share concepts related to science, art, and technology with individuals all over the world.

In terms of its qualities, the CLIL approach is believed to create meaningful content for meaningful learning and offer more productive relationships, communication scenarios, and chances that engage students (Barre-Parrales & Villafuerte-Holguín, 2021, p. 100). Additionally, Mayora and Gutiérrez (2019) discovered that learners exhibit more positive attitudes toward learning a target language while adopting CLIL as the primary tool for studying EFL (Barre-Parrales & Villafuerte-Holguín, 2021, p. 100). Furthermore, CLIL promotes a deeper degree of absorption among pupils exposed to similar languages and linguistic roles. The study by Karimi et al. (2019) also demonstrated that lessons that employ the CLIL methodology are more appealing and accessible to groups of English language learners. However, as noted by Barrios & Milla-Lara (2020) and Antropova et al. (2021), improper CLIL implementation might have a detrimental effect on students' academic performance (Barre-Parrales & Villafuerte-Holguín, 2021, p. 100).

2.2. Legislative framework

2.2.1. Common European Framework of Reference for Languages

The eight competencies for lifelong learning—personal fulfilment, a healthy and sustainable lifestyle, employability, active citizenship, and social inclusion—are significantly advanced by the Common European Framework (CEFR, 2020). For European students, multilingualism—one of the eight essential competencies—enhances global competencies, cultural awareness, and cognitive capacities, particularly when CLIL is employed in secondary education (Byram, 2009, p. 7). The CEFR distinguishes between plurilingualism

(the dynamic and evolving linguistic repertoire of an individual user/learner) and multilingualism (the coexistence of various languages at the social or individual level). The Common European Framework Companion Volume has lately raised awareness of the long-standing need to improve learners' plurilingual competency. Here, the encouragement of an action-oriented approach that emphasises meaningful, cooperative classroom activities rather than just language learning (CoE, 2020, p. 30) highlights the fact that language acquisition encompasses a range of subject areas where language is integrated as part of the learning process in addition to traditional language classes. This is consistent with the CLIL approach, which combines language and content learning to ensure that students gain both language competency and subject-specific knowledge.

The CEFR describes plurilingualism as an uneven and fluctuating competence, where a user's or learner's resources in one language or variety may differ greatly from those in another. The ability to employ an interconnected, uneven, plurilingual repertoire with flexibility is a key component of plurilingual competence (Coste et al., 2009, p. 9). It includes:

1. **Repertoires of Language:** This factor refers to the variety of languages and dialects that an individual can speak, even if they are not fully fluent in any of them. For instance, a person may be able to converse in Spanish, comprehend basic German, and speak English and French with ease.
2. **Code-Switching:** the capacity to transition between languages or dialects in various situations, often even during a single discussion.
3. **Interlanguaging** utilises all available linguistic resources to create meaning by incorporating parts of several languages into a single document or speech.
4. **Intercultural Proficiency:** the capacity to negotiate contacts in a way that is appropriate for one's culture, as well as an awareness of and respect for cultural differences.
5. **Metalinguistic Awareness:** The capacity to consider and evaluate language use, as well as an understanding of how languages function. For instance, a young reader may realise that many English words have different spellings from their sounds and start to comprehend why.

6. Strategic Proficiency: the capacity to employ techniques for successful communication despite language proficiency disparities.
7. Proficiency in Pluriculture Communication can be improved by comprehending and utilising cultural knowledge.
8. Partial Proficiency: The understanding that people can have varied levels of ability in multiple languages, frequently being good at one thing (like speaking) but not another (like writing). For instance, an immigrant may have trouble reading and writing the local language but be able to speak and comprehend it with ease.
9. Mediation of Language facilitates cross-linguistic contact through interpretation or translation.
10. Adaptive Capabilities: the ability to modify language use for various contexts and audiences. For instance, a student may speak informally among friends but formally in an academic article.

Therefore, acknowledging learners as multilingual and multicultural individuals entails encouraging them to recognise the similarities and contrasts between different languages and cultures while also allowing them to use their entire range of linguistic abilities when necessary (CoE, 2020, p. 30). One of the eight essential skills that students in Spain must master by the completion of their mandatory education is plurilingualism (Orden EFP/754/2022). Students must successfully use one or more foreign languages after completing their mandatory education to meet their communication demands in a variety of contexts, including social, professional, educational, and personal. While regional languages, such as Catalan, Galician, and Basque, are also taught and utilised as instructional languages in their respective autonomous communities, Spanish, the country's official language, serves as the main teaching medium (Promised, 2024, p. 11).

2.2.2. LOMLOE

The foreign language course directly contributes to the development of plurilingual competence, which entails the appropriate and efficient use of various languages for learning and communication, as well as the acquisition of the various key competencies that comprise the student profile upon completion of basic education (LOMLOE, 2020). In addition to the communicative dimension, multilingualism encompasses historical and intercultural elements

that enable students to comprehend, appreciate, and respect language and cultural diversity, fostering their engagement in autonomous, active citizenship dedicated to a democratic society. According to this method, the primary goals of the Foreign Language course in Compulsory Secondary Education are the development of appropriate communicative competence in the foreign language, which enables students to comprehend, communicate, and engage with others in that language, as well as the enhancement and broadening of their intercultural awareness (LOMLOE, 2020).

The communicative and intercultural aspects of plurilingualism are integral to the core of the foreign language program. Subject-specific competencies allow students to expand their individual linguistic repertoire, improve communication in both their native and foreign languages, and communicate effectively and appropriately in the foreign language (LOMLOE, 2020). These competencies are linked to the descriptors of the various key competencies outlined in the Graduate Profile and to the challenges of the twenty-first century. To advance sustainability and democracy, it is also crucial to respect and value individual linguistic profiles, accept and adapt to cultural diversity, and respect other languages and intercultural communication (LOMLOE, 2020).

Additionally, this course helps students access cultures communicated through the foreign language and cross digital environments more skillfully, serving as a source of knowledge and entertainment as well as a catalyst for education and learning. In this sense, digital tools have the potential to be fully utilised to support foreign language and culture learning, instruction, and evaluation (LOMLOE, 2020). Thus, a crucial component of this subject's curriculum is the development of critical thinking, media literacy, and the appropriate, safe, ethical, and responsible use of technology.

The subject-specific foreign language competences for compulsory secondary education will be developed utilising the students' prior knowledge and experiences. This suggests that communicative activities and strategies for comprehension, production, interaction, and mediation have been expanded and deepened (LOMLOE, 2020). At this point, it is understood to be an activity that aims to clarify concepts and simplify messages to promote mutual understanding and convey information. Considering how languages work and the connections between the various languages in students' particular repertoires, a more prominent role is another aspect of this evolution (LOMLOE, 2020). To teach students how to behave with empathy and respect in cross-cultural communication scenarios, the foreign

language course's unique abilities also include an appreciation of and adaptation to linguistic, artistic, and cultural variety among students.

Students are provided with the subject's assessment criteria, which establish the extent to which they have mastered the particular competencies (LOMLOE, 2020). They are expressed in their competency-based formulation by outlining the procedure or skill that students need to learn, as well as the context or method of using and applying that procedure or skill. The Common European Framework of Reference for Languages (CEFR) serves as the foundation for aligning evaluation criteria, which have been modified to take into account the maturity and psycho-developmental stage of secondary school pupils (LOMLOE, 2020).

For their part, the core competencies support the evaluation of learning using these criteria by combining the knowledge (knowing), abilities (know-how), and attitudes (being) required to acquire subject-specific competencies (LOMLOE, 2020). They are divided into three blocks. The knowledge required to carry out communication actions, involving understanding, production, interaction, and mediation—including those pertaining to finding information sources and controlling the sources consulted—is covered in the “Communication” block (Real Decreto 217/2022). To enhance the languages that comprise students' linguistic repertoire and help in the acquisition of foreign languages, the “Multilingualism” portion incorporates the knowledge about the capacity to reflect on how languages work (Real Decreto 217/2022). Lastly, “Interculturality” compiles information about the cultures represented by the foreign language and their appreciation as an opportunity for social interaction and enrichment. Additionally, this area contains information intended to cultivate attitudes of interest in comprehending and respecting different languages, linguistic variants, and civilisations (Real Decreto 217/2022).

The language activities and competences defined by the Council of Europe in the CEFR serve as the foundation for the methodology, grading, and definition of the many curriculum components (LOMLOE, 2020). In addition to supporting students' learning process, which is recognised as dynamic and continuous, flexible and open, and must be tailored to their circumstances, needs, and interests, this tool is essential for identifying the many levels of proficiency that students achieve via diverse activities (LOMLOE, 2020). The Sustainable Development Goals and the challenges of the twenty-first century are just two examples of the everyday topics that students are expected to be able to apply all of their basic knowledge in communicative situations typical of various spheres—personal, social, educational, and

professional—and based on texts (LOMLOE, 2020). The competency-based nature of this curriculum encourages teachers to design interdisciplinary, contextualised, meaningful, and relevant tasks and to create learning situations where students are viewed as increasingly autonomous social agents who are gradually responsible for their own learning process, in keeping with the action-oriented approach suggested by the CEFR, which greatly contributes to the design of eclectic methodologies. This entails building the foundation for lifetime learning by considering their knowledge, interests, emotions, and unique circumstances (LOMLOE, 2020).

2.2.3. Education for Sustainability, Climate Awareness, and SDG

The Sustainable Development Goals (SDGs) are a set of 17 global targets adopted by the United Nations (UN) in 2015 to eradicate poverty, protect the planet and ensure peace and prosperity for all people by 2030.

They understand that efforts to combat climate change and protect our oceans and forests must coexist with measures that enhance health and education, lessen inequality, and promote economic growth to eradicate poverty and other forms of deprivation. The United Nations Department of Economic and Social Affairs Division for Sustainable Development Goals (DSDG) now offers significant assistance and capacity-building for the SDGs and their associated thematic issues, such as water, energy, climate, oceans, urbanisation, transportation, science and technology, the Global Sustainable Development Report, partnerships, and Small Island Developing States. DSDG is crucial to the assessment of the UN system's implementation of the 2030 Agenda, as well as to outreach and advocacy efforts related to the SDGs. Broad ownership of the SDGs must result in a strong commitment from all stakeholders to carry out the global goals if the 2030 Agenda is to become a reality. This engagement is intended to be facilitated by DSDG.

This project aligns with SDGs, which place sustainability as a transversal axis of the curriculum. Special focus is given to:

- Goal 6: Clean Water and Sanitation
- Goal 7: Affordable and Clean Energy
- Goal 13: Climate Action

- Goal 15: Life on Land
- Goal 17: Partnership for the Goals

Science fiction facilitates critical thinking by allowing the analysis of actual problems from an imaginary context, which reduces students' emotional resistance.

2.3. *STEAM*

STEAM is an evolving educational concept that shows how the conventional academic areas of science, technology, engineering, arts, and mathematics may be organised into a framework for designing an integrative curriculum (Bautista, 2021, p. 756). Despite being a complicated and contentious concept, STEAM has gained popularity in the field of education since Yakman first introduced the acronym at the start of the twenty-first century (Bautista, 2021, p. 756). The advocates of STEAM education have emphasised the need for innovative pedagogy in the classroom, or more specifically, the need to dismantle barriers between disciplines that have historically been taught separately. The inclusion of the "A" for arts, which encompasses a variety of fields from the humanities, social sciences, and fine arts, distinguishes STEAM from STEM, the previous trend (Bautista, 2021, p. 756). Their inclusion highlights the value of creativity in students' learning and development, which is recognised as crucial for progress and innovation (Bautista, 2021, p. 756). STEAM-interested authors concur that teaching and learning should be centred on practical projects that enable students to comprehend, evaluate, and effectively manage technoscientific problems that arise in daily life. Additionally, Bautista (2021) mentions that STEAM emphasises the significance of tackling issues with a spirit of innovation and ethical responsibility.

Practically speaking, STEAM education is defined by the pursuit of meaningful learning and the stimulation of students' divergent (common in the arts) and convergent (common in STEM) thinking (Bautista, 2021, p. 756). According to Bautista (2021), STEAM is also defined by giving students an active, constructive, and critical role in their learning and encouraging collaborative work, while the instructor takes on the roles of advisor, counsellor, and/or guide. In addition to fostering students' sense of self-efficacy, confidence, and drive for techno-scientific learning, STEAM aims to support students in creating personal meaning (Bautista, 2021, p. 756). From the standpoint of curriculum design, several writers have suggested interdisciplinary models that incorporate material from at least two of the disciplines represented by the acronym (S-T-E-A-M) (Bautista, 2021, p. 756). Others have

developed transdisciplinary models, whose primary goal is to solve a particular issue (real or imagined). Students must investigate and make connections between material from several fields to accomplish this (Bautista, 2021, p. 757). The STEAM literature has recently concentrated on describing cutting-edge methods and educational experiments at various educational levels (STEAM pedagogies), their beneficial effects on students (STEAM competences), such as the development of professional interests (STEAM attitudes), and the improvement of school learning environments (STEAM classrooms) (Bautista, 2021, p. 757). The disciplinary model, which teaches curriculum subjects independently and in isolation, is the most common educational approach in schools, particularly in secondary education, despite the expanding body of STEAM research (Bautista, 2021, p. 757).

In the twenty-first century, it has evolved into a crucial strategy and is becoming more noticeable at all educational levels. The growth of programs highlighting the significance of this information and its practical implementation in academic contexts is indicative of this trend. In a similar spirit, meaning and Language Integrated Learning (CLIL) is acknowledged as a crucial approach in the field of education, wherein the substance of courses, such as science or technology, is taught using a language other than the mother tongue (Luelmo del Castillo et al., 2025, p. 187). The growth of bilingual programs in Europe over the past 20 years, particularly in Spain, where STE(A)M fields are included in the curriculum taught in the target language, is a clear example of this. Organisations like the Organisation for Economic Cooperation and Development have recognised the importance of STE(A)M education for a nation's economic and social development, as well as the potential of the CLIL methodology as a tool for language instruction and skill acquisition (Luelmo del Castillo et al., 2025, p. 187).

Language and STE(A)M fields are crucial in the context of globalisation to access scientific and technological knowledge globally, promote innovation fueled by cultural diversity, and remain competitive in a globalised labour market (Luelmo del Castillo et al., 2025, p. 187). STEM not only promotes a deep understanding of its theoretical foundations but also their practical application in a variety of contexts, from everyday situations to cutting-edge scientific projects and technological breakthroughs. Through this approach, STE(A)M gives students the diverse perspectives and skills necessary for success in a variety of industries and occupations. Students gain a deeper, more meaningful understanding of STE(A)M principles through this cyclical process of engagement, inquiry, explanation,

elaboration, and evaluation, which eventually equips them to solve real-world problems (Luelmo del Castillo et al., 2025, p. 187).

Overall, since students must share their ideas, findings, and reflections, while teachers present scenarios or material intended to pique students' interest, spark curiosity, and activate their prior knowledge, communication and interaction are also essential components of these educational approaches. As a result, learning becomes an ongoing process of growth in which students discover new material, enhance their abilities, and comprehend one or more subjects (Luelmo del Castillo et al., 2025, p. 189). Additionally, both STE(A)M and CLIL place a strong emphasis on the development of cognitive skills, such as critical thinking and problem-solving, stressing the ability to connect, assess, synthesise, and apply knowledge in a variety of contexts rather than simply memorising it. Moreover, culture plays a significant role in both strategies for dealing with the global problems of the twenty-first century. Students need to be able to act civilly in different cultural settings. Understanding culture involves making decisions, engaging in civic life, and appreciating and respecting cultural variety (Luelmo del Castillo et al., 2025, p. 189). These components are crucial because they help students develop and strengthen their intercultural skills and global awareness.

2.4. Active Methodologies in EFL

2.4.1. Project-Based Learning

Three constructivist tenets underpin project-based learning (PBL), a student-centred approach to education: learning is context-specific, students actively participate in the process, and they accomplish their objectives through social interactions and the sharing of knowledge and understanding (Kokotsaki et al., 2016, p. 268). It is considered a specific type of inquiry-based learning, in which real-world problems and authentic questions are used to create the learning context, resulting in significant learning experiences (Kokotsaki et al., 2016, p. 268).

There are obvious links between PBL and other pedagogical techniques, including problem-based learning. In both, the idea is for individuals to work together to achieve a common objective (Kokotsaki et al., 2016, p. 268). To build and present the final product in response to the driving question, students may run into issues during their project involvement. The primary distinction between the two is that PBL must result in a final

output, while students in problem-based learning are primarily focused on the learning process. Additionally, PBL has been contrasted with other pedagogical approaches, such as collaborative or experiential learning (Kokotsaki et al., 2016, p. 268). According to Helle et al. (2006), project work contains components of experiential learning, including active reflection and intentional participation rather than passive experiences, which are crucial. Moreover, it is a collaborative type of learning, as all participants must contribute to the shared conclusion (Kokotsaki et al., 2016, p. 268).

This approach enhances students' problem-solving abilities, helps them retain what they have learned, and provides opportunities for cooperative information structuring (Genc, 2015, pp. 106-107). According to Nation (2008), project-based learning allows students to apply their critical thinking and problem-solving abilities while providing them with practical experience (Genc, 2015, p. 107). The goal of project-based learning is to help aspiring educators develop knowledge, capabilities, and attitudes for a sustainable environment. Significant progress toward a sustainable environment can be achieved by using efficient environmental education techniques (Genc, 2015, p. 107).

Since sustainability involves various challenges whose dynamism and complexity are frequently demonstrated through practical experience, project-based learning is suitable for conducting classwork around sustainable development.

While there are many ways to use PBL, an effective project should fulfill eight requirements: address a difficult problem or question; maintain inquiry; create authenticity; use students' voice and choice; reflect on the work; critique and revise the work; and produce a public product; all to grasp important knowledge, understanding, and successful skills for the future (Cox & Meaney, 2018, p. 25). These eight criteria provide instructors and students with a fruitful basis on which to build meaningful objects from questions and concepts.

2.4.2. Gamification

In teacher education, gamification is acknowledged as a successful strategy for boosting motivation. Gamification is the technique of incorporating game elements—such as points, badges, levels, and storytelling—into instructional procedures, rather than depending solely on full-scale games (Konuk & Fidan, 2026, p. 20). Gamification is a supplementary tactic to increase motivation and engagement, in contrast to game-based learning, which concentrates on games themselves.

By meeting pre-service teachers' psychological demands for autonomy, competence, and relatedness, personalised gamification designs enhance their intrinsic motivation and increase learner engagement (Konuk & Fidan, 2026, p. 20). Through optional and entertaining tasks, gamified evaluation systems further increase motivation and satisfaction while favourably influencing pre-service teachers' attitudes toward cutting-edge teaching techniques (Konuk & Fidan, 2026, p. 20). Furthermore, effective use of gamification components, such as points, badges, and storytelling, increases student engagement and interest while fostering critical thinking and collaboration abilities (Konuk & Fidan, 2026, p. 20).

In international classroom settings, Learning English as a Second Language (ESL) is essential for group work and communication as well as for international, political, and cultural communication (Dehghanzadeh et al., 2021, p. 934). The necessity of learning ESL to interact with students from various countries has rapidly increased due to the development of new digital technologies. A change from conventional to advanced learning approaches is necessary due to the quick demand for ESL (Dehghanzadeh et al., 2021, p. 935). This change is particularly crucial because students frequently complain that ESL is difficult, demanding, and stressful, especially when it comes to using its many skills (such as speaking, writing, reading, and listening) in authentic contexts. According to scientific research, gamified learning environments for ESL may foster students' motivation, engagement, and ability to fail without fear (Dehghanzadeh et al., 2021, p. 935). In this sense, it is necessary to consider students' attitudes and feelings regarding gamification during ESL. To meet the needs of the growing number of students engaged with ESL, teaching methods and tactics should be developed to consider students' experiences and increase their motivation and engagement.

One of the most entertaining, captivating, and successful approaches for ESL is gamification. The rationale is that different components (dynamics and mechanics) integrated into gamified environments can boost students' motivation and interest in learning English, lessen their anxiety and fear of speaking a foreign language in public, and ultimately help them develop a positive learning behaviour (Dehghanzadeh et al., 2021, p. 935).

The term "serious games" is primarily educational rather than merely entertaining and offers numerous opportunities to link education to students' everyday experiences (Dehghanzadeh et al., 2021, p. 936). The game techniques used in educational games can pique players' interest. Through gameplay, both serious and instructional games can help players improve their abilities and knowledge. Gamification utilises game aspects to help

students interact with the material and move closer to a goal (Dehghanzadeh et al., 2021, p. 936). According to Bunchball (2010), game mechanics refers to the basic actions, procedures, and control mechanisms used to “gamify” an activity, providing students with engaging experiences. Point, level, badges, leaderboard, charity, and presents, challenge, space, storytelling, and virtual goods are just a few examples of game mechanics (Dehghanzadeh et al., 2021, p. 936). Learners’ emotions are triggered, stimulated, and driven by game dynamics.

2.4.3. ICTs in the educational field

Computers are becoming an essential tool for daily life. They serve as a portal to the World Wide Web, which is the primary explanation. The importance of educational technology has increased due to ongoing advancements in computer technology and the availability of the Internet for most educators. Every educational institution needs a framework that gives its faculty members the tools they need to promote greater institutional involvement (Salehi et al., 2015, p. 63). The growing prominence, functions, and expense of educational technology in classrooms today are a constant source of contention. Numerous studies have indicated that incorporating technology can boost learning, increase motivation, and improve academic achievement (Salehi et al., 2015, p. 63).

E-learning, which is the delivery of instruction and training to students over the World Wide Web, is a complex notion today. Different people can access virtual learning environments (VLEs), learning management systems (LMS), web-based training (WBT), and other e-learning apps and educational technology within these higher education institutions (Salehi et al., 2015, p. 63). All three components of the three-component model—content, communication, and construction—must be considered and made accessible to make e-learning and educational technology accessible (Salehi et al., 2015, p. 65). By integrating into this learning management system, learners have a variety of standardised user interface opportunities and content production and adaptation are made easier. Additionally, it is critical to guarantee platform scalability, support for portability and standards, and content customisation in these virtual learning environments. According to Salehi et al. (2015), ICT can enhance students’ understanding of IT when applied appropriately. Additionally, it can equip students with IT awareness and capabilities that are critical for success in today’s information economy, helping them use the necessary talents.

The OECD stated in 2018 that education is essential for helping people acquire the knowledge, abilities, attitudes, and values necessary to contribute to and profit from an

inclusive and sustainable future (Kabdualiyev et al., 2025, p. 161). In the upcoming years, it will be crucial to learn how to set specific, meaningful goals, collaborate with others who have diverse viewpoints, spot unexplored opportunities, and recognise several approaches to complex issues. Education should strive to equip students with the skills they need to become engaged, responsible, and active citizens rather than just preparing them for the workforce (Kabdualiyev et al., 2025, p. 161).

Enhancing the future teachers' ICT proficiency while also equipping students to prosper in a technologically advanced, knowledge-based society is important. Ghavifekr and Rosdy (2015) assert that ICT proficiency now encompasses much more than just using computer programs (Kabdualiyev et al., 2025, p. 161). It describes a teacher's ability to utilise technology in the classroom in ways that encourage students' creativity, critical thinking, and problem-solving abilities.

As the science of life, biology is inextricably linked to the study of complex systems through observation, investigation, and interpretation. In recent years, the integration of information and communication technology (ICT) has transformed the way biology is taught and studied in various educational settings. Digital tools present both educational opportunities and challenges, ranging from co-designed simulations and adaptive courseware to virtual laboratories (Kollarou, 2025, p. 63).

ICT has been welcomed by educators worldwide to promote inquiry-based learning, illustrate abstract biological processes, and encourage classroom collaboration (Kollarou, 2025, p. 63). Biology has transitioned from static textbook illustrations to interactive experiences thanks to virtual dissection tools, animated models of DNA replication, and game-based ecosystems (Kollarou, 2025, p. 63).

Finally, teenagers are especially engaged in game-based learning. A thorough review by Situmorang et al. (2024) demonstrated that when biology games are created with educational objectives in mind, they improve conceptual knowledge and memory (Kollarou, 2025, pp. 64-65). Greek secondary biology teachers have started experimenting with platforms and apps that simulate cellular processes or ecological systems, fusing academic rigour with fun. ICT serves as a tool for clarification as well as "engagement," providing guided explanations, low-distraction design, and sequenced animations that promote conceptual economy (Kollarou, 2025, p. 67).

2.4.4. Integrative Models and Biology

The English language connects people from all over the world in their personal, professional, and academic lives. According to Meyerhöffer and Dreesmann (2019), having adequate receptive and productive language abilities is now a basic prerequisite for anyone hoping to engage and navigate today's globalised society. Primary and secondary education institutions are typically responsible for teaching and fostering these abilities in children and young people. This frequently occurs in conventional language classes that emphasise the literature, culture, and history of the target language's home countries. A growing number of European schools are offering courses where the majority of the subject matter is taught in a foreign target language, following a trend that began to flourish in the 1990s (Meyerhöffer & Dreesmann, 2019, p. 1367). Such bilingual lectures address a fundamental issue with traditional language classrooms by automatically offering relevant subjects for discussion (Meyerhöffer & Dreesmann, 2019, p. 1367).

English is by far the most common target language in CLIL contexts, as it is important for global communication. Numerous studies have demonstrated that English-bilingual education improves students' language proficiency (Meyerhöffer & Dreesmann, 2019, p. 1367).

Several aspects of the natural sciences are beneficial for multilingual education. According to Meyerhöffer and Dreesmann (2019), visual aids, including schematics, graphs, and models, are frequently used in the approach. Meyerhöffer and Dreesmann (2019) highlight the highly standardised vocabulary and simplified syntax of scientific writing forms, which, from the learner's point of view, make their meaning easy to acquire and replicate. These norms serve the texts' purpose of communicating information in a coherent, overgrown, and unambiguous form in representative genres such as the scientific journal article or the laboratory report. It is significant to note that this is particularly true for texts in the social sciences, which are more complex to understand because they are frequently heavily influenced by sociocultural perspectives (Meyerhöffer & Dreesmann, 2019, p. 1368). In the context of bilingual education, the abundance of scientific terms in the life sciences may initially suggest an even greater cognitive load because students will need to retain both the local language phrase and its English equivalent. However, it is frequently the case that scientific phrases are borrowed from Latin or Greek and are therefore identical or extremely similar in English, as shown by Meyerhöffer and Dreesmann (2019). As a result, cognitive

demands remain similar to those in classes that are not multilingual science classes. Additionally, students' conversational vocabulary can be expanded by applying scientific register English words in daily situations. Therefore, science classes are a great fit for bilingual education because they provide a discourse culture centred on facts, clarity, and directness (Meyerhöffer & Dreesmann, 2019, p. 1368).

Research on the acquisition of second languages has consistently demonstrated that learning a second language through content is most effective when students have a genuine learning goal and when language use is rich, authentic, and meaningful to them (Dong, 2002, p. 41). According to different studies, learning academic content knowledge and a second language may be more beneficial for non-native English speakers. Learning a new language in the target language and within the actual context of disciplinary-specific language use, such as biology and social studies, is one of the finest methods. Moreover, learning a language with relevant content increases motivation and offers genuine social goals for speaking, listening, reading, writing, and thinking (Dong, 2002, p. 42). A shift in pedagogy is needed for all teachers to integrate language and content instruction, creating rich and authentic contexts for language learning. This is important because the student body in many public schools is changing, and many ESL students spend a lot of time with their subject matter area teachers during the day (Dong, 2002, p. 42). As a result, content area teachers must collaborate with ESL/bilingual teachers to educate ESL students by learning specific strategies for interacting with ESL learners, becoming informed about issues related to second language acquisition, and offering instruction that integrates language and content (Dong, 2002, p. 42).

Both language acquisition and academic content learning can be improved by recognising and utilising the student's prior life and educational experiences (Dong, 2002, p. 42). With the right prodding and scaffolding, second language learners may apply their experiences and knowledge from their home schooling to the new learning environment. For instance, even though pupils may not be familiar with the English term for photosynthesis, they may already understand the concept in their mother tongue (Dong, 2002, p. 42). Therefore, content-specific concept learning accelerates after the subject matter teacher determines what the students already know and assists them in drawing connections between what they are learning now and what they already know. This is because kids need to learn a new way to express the old concept (Dong, 2002, p. 42). Therefore, the subject teacher should look for what the students already know and build on a comprehension of the new knowledge

from there rather than concentrating on what second language learners do not know (Dong, 2002, p. 42).

Interestingly, secondary students regarded classroom science as “boring” and “irrelevant” to their everyday lives, although generally agreeing that science was “valuable” and “important” (Tretter et al., 2019, p. 1017). According to Tretter et al. (2019), it would be “difficult, if not impossible”, to maintain positive attitudes toward science in the absence of the “essential ingredient of relevance”. In fact, one study found that student science attitudes had a stronger influence on students’ decision to choose a STEM major than did enrollment or accomplishment among the school-based characteristics they examined (Tretter et al., 2019, p. 1017).

The majority of positive science attitudes, according to Osborne et al., were linked to “students’ positive experience of extracurricular activities and the nature of in-class activities,” including teachers’ “being enthusiastic about their subject, setting it in everyday contexts, and running well-ordered and stimulating science lessons... establishing a range of varied learning opportunities”. Variety was, above all, “the spice of science education” and “the key factor in generating interest in science” (Tretter et al., 2019, p. 1017).

According to Tretter et al. (2019), isolating the scientific phenomenon under study from its temporal contexts and interconnected phenomena makes it difficult to teach many science concepts (e.g., causes of seasons, moon phases), which in turn puts a high cognitive processing demand on the learner. The usual high reliance on language to engage students in science activities, such as extensive reading, listening to instructor lectures, and sharing ideas with others, presents another difficulty for emerging ELs. However, by assisting students in developing internal representations, or mental models, based on directly experiencing external (visual) representations, the use of visually-rich media (such as immersive and interactive visualisations delivered via a planetarium experience, further referred to as visualisations) can largely overcome language barriers (Tretter et al., 2019, p. 1018). Telescopic surveys, simulation software, and satellites “allow scientists to build virtual and interactive worlds populated with direct observations, enabling visualisation capability with authentic data rather than with artistic renderings” (Tretter et al., 2019, p. 1019). These scientific visualisation techniques are beginning to be utilised in education to help both ELs and non-ELs learn (Tretter et al., 2019, p. 1019). To put it another way, immersive and interactive visualisations

could help develop more favourable attitudes toward learning and the discipline, as well as good learning experiences.

A second strand of literacy and science integration focuses on science-related reading utilising carefully chosen trade publications, in addition to explicit, structured vocabulary education. To improve students' comprehension of science concepts and practices and to better understand how scientists conduct science, experts have advocated the use of comic and illustrated trade books in teaching science (Tretter et al., 2019, p. 1020). Using comic and illustrated trade books as resources to expand students' background knowledge, inspire or refine their questions, or serve as references for validating students' results would support students' scientific investigations and engagement in the practices of science and engineering, ultimately improving achievement and attitudes. In fact, several studies have demonstrated the advantages of combining science with reading (Tretter et al., 2019, p. 1020).

2.4.5. Storytelling through the use of comics

Humanity has long used narrative to educate and comprehend the world, making it one of the first modes of communication and education. Incorporating literary works into L2 instruction in middle and high school can spark students' creativity, promote independent thought, and enable them to draw their own conclusions. Beyond cognitive growth, students can enhance their comprehension of diverse cultures, as well as their ability to communicate in a foreign language. Incorporating narrative into language learning promotes communication and can act as a common thread for knowledge creation (Fischbach, 2015, p. 604). We can tailor these stories to the interests of our middle and high school kids because they are available in a variety of formats and genres. Graphic novels and comic books are narrative forms that are useful for language acquisition. These publications often pique students' curiosity, which encourages a positive outlook and greater motivation in the classroom. To aid in understanding and learning, this story employs a dynamic language that combines two distinct codes—verbal and visual—arranged in a complementary and sequential manner. These characteristics make reading enjoyable and quick. Students will choose information, make choices, and interpret the material in front of them as a result of reading visuals, which will enable them to organise and make sense of the information that is presented to them (Fischbach, 2015, p. 604). However, the teacher is crucial to understanding the pictures correctly. These can occasionally hold a distinct cultural and symbolic grade that needs to be properly understood. Conversely, comics provide specific information through codes created

and approved by the viewer, such as speech bubbles, vignettes, labels, plans, onomatopoeia, or visual metaphors. Both individual and group work in the classroom will benefit from this diversity of content—linguistic, iconic, and cultural (Fischbach, 2015, p. 604).

Overall, one potentially helpful option for developing the Content and Language Integrated Learning (CLIL) method in middle and high school is the use of comics and graphic novels in language teaching contexts to work on topics from other subjects. Language learning and acquisition must not be overlooked. The linguistic and iconic character of the input that pupils are exposed to helps them comprehend the comic's content. It allows for the simultaneous introduction of vocabulary, language structures, and sociocultural elements while simulating conversation scenarios. This material has been utilised in language classrooms as a means of working on linguistic content in communicative contexts (Promised, 2024, p. 38).

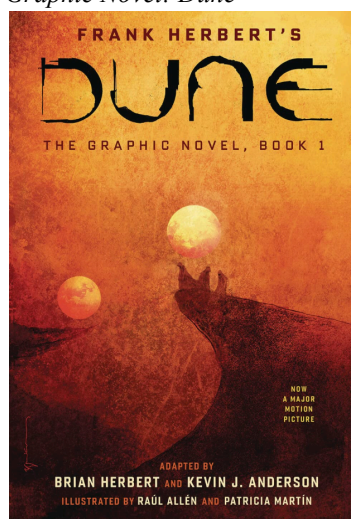
3. Proposal of didactical unit

3.1. *Dune*

The first graphic novel adaptation of *Dune* was written by Brian Herbert and Kevin J. Anderson, based on Frank Herbert's work, in 2020.

Figure 2

Graphic Novel: Dune



Note: A photograph of the cover of *Dune* by Brian Herbert and Kevin J. Anderson

The first part of the novel tells the story of the Atreides family, consisting of Duke Leto, Paul Atreides, and Jessica Atreides. They live on Caladan, a planet with habitable conditions similar to Earth's. In this universe, spices are very important, as they provide both purchasing

power and navigational capabilities. For this reason, the Duke and his family travel to Arrakis, a planet with scarce water and resources, similar to Mars. On this planet, live the Fremen, who know the Arrakis desert inside out; Harkonnens, who seek power and control over the planet; a team of scientists investigating the planet's composition; and the planet's inhabitants.

In this part of the novel, the Atreides family travels to Arrakis with the intention of controlling the planet and saving the population from the Harkonnens. When they arrive on Arrakis, problems begin to arise as the Harkonnens attempt to kill them. As the novel progresses, the Atreides family begins to discover that their own people have betrayed them. Paul and Jessica are captured by the Harkonnens and sent into the desert. Moreover, the Duke is killed by the Harkonnens. In the desert, Paul and Jessica find refuge and attempt to figure out how to ask the Fremen for help. Furthermore, Paul discovers that he is not entirely of Atreides descent, but that Harkonnen blood runs through his veins.

Finally, the graphic novel concludes with this revelation, leaving us wondering what will ultimately become of Paul and Jessica.

As we follow the story of the Atreides, we discover a tale filled with adventure, environmentalism, and politics, a story that the students will explore in the different sessions.

3.2. Objectives

The objective of this project is to employ the theme of planets and the graphic novel *Dune* to foster climate awareness. In other words, students use *Dune* to understand the future of the planet, since Arrakis represents water scarcity, desertification, resource exploitation, and environmental inequality—problems that the Earth faces today.

The project was conducted in collaboration with the biology and English departments. Although the project initially involved only 12 students from the fourth-year bilingual classes C and E, it was eventually combined with the other fourth-year bilingual class C, so that all students would have the opportunity to complete the final biology project as well.

The narrative thread is as follows: Students participate in an international mission to study the planet Arrakis and design a new sustainable planet in response to Earth's climate crisis. The challenge is to investigate how science fiction reflects real environmental problems and to create a habitable proposal aligned with the SDGs. As a final product, they will give a

presentation as if they were influencers selected for a social media campaign. They will defend their sustainable planet, the ecological decisions made, and the influence of *Dune* on their thinking.

Since we have worked jointly with the biology department, the final products and objectives have differed in each subject:

Scientific Objectives in Biology

Students should be able to:

- SC²1: Critically analyse how science fiction can reflect real environmental issues. Students will interpret the science of the natural world.
- SC2: 2.1: Understand the conditions necessary for the habitability of planets based on scientific evidence. Students will analyse ecosystems and natural resources.
- SC2: 2.2: Formulate hypotheses about the possibility of life on other planets using scientific evidence.
- SC3: Analyse the relationship between climate, extreme ecosystems, and the adaptations of living organisms.
- SC5: 5.1: Relate abiotic and biotic factors in the construction of sustainable ecosystems.
- SC5: 5.2: Relate the fictional ecosystems of Arrakis to real environmental issues on Earth.
- SC6: 6.1: Propose sustainable solutions for water management, biodiversity, and energy.
- SC6: 6.2: Design a habitable planet by applying scientific knowledge about the atmosphere, natural resources, and sustainability.

Language Objectives

- SC1: Use specific vocabulary related to space, ecosystems, and climate change.

² Specific Competence

- SC2: Understand visual and narrative texts in English based on the graphic novel.
- SC3: Express hypotheses, descriptions, and opinions using appropriate linguistic structures.
- SC4: Actively participate in formal cooperative oral interactions simulating international scientific contexts using English as the language of instruction.
- SC3/SC4: Produce oral and written work related to the creation and defence of a sustainable planet.
- SC5: 5.1: Correctly use reported speech to convey scientific information and messages within the project.
- SC5: 5.2: Use relative pronouns to describe ecosystems, species, and natural processes.

Eco-social objectives:

- Understand the impacts of human activity on ecosystems and the responsibility it entails for conserving the planet. This specific competency connects with the following descriptors of the STEM Exit Profile: Personal, Social and Learning-to-Learn Competence (PSLLC).
- Adopt responsible habits toward the environment and sustainable development. This specific competency connects with the following Exit Profile descriptors: Citizen Competence (CC).
- Relate the narrative of *Dune* to the SDGs. This specific competency connects with the following Exit Profile descriptors: Competence in Cultural Awareness and Expressions (CCAEE).
- Propose sustainable solutions applicable to real-world contexts. This specific competency aligns with the following Learning Outcome Profile descriptors: PSLLC, SC1.

Methodological and Competency Objectives

- Use digital tools to document the learning process. This specific competency aligns with the following Learning Outcome Profile descriptors: Digital Competence (DC).
- Develop creativity through the narrative and scientific reinterpretation of the studied graphic novel. This specific competency is linked to the following Learning Outcome Profile descriptors: CCAE.
- Actively participate in gamified activities and immersive learning experiences. This specific competency is linked to the following Learning Outcome Profile descriptors: PSLLC.
- Communicate results and conclusions in a clear and structured manner. This specific competency is linked to the following Learning Outcome Profile descriptors: Linguistic Communication Competence (LCC).

3.3. Sessions

The English and biology sessions have been completely different, as the graphic novel has been used exclusively in the English subject. In biology, other activities have been accomplished, building on the English sessions, to allow students to complete various missions.

With the narrative of *Dune* in mind, students arrive on Arrakis, where they analyse the ecosystem, design adapted living organisms, and explain how they survive.

The use of fictional planets, such as Arrakis, helps raise students' awareness of the importance of sustainability on Earth by comparing extreme conditions to those on our planet.

3.3.1. English Sessions

The **first session** begins with a brief introduction to the biology topic: Planets. The objective of this first session is to introduce the concepts of planets and habitability, as well as water scarcity and climate change, and to engage students in scientific vocabulary in English, promoting communicative and intuitive learning. It also focuses on linguistic and conceptual preparation.

Under the theme “Exploring Outer Space,” the session begins with an introduction to the planet’s habitability. To accomplish this, I will project three different images: one of a

desert, another of water scarcity, and a third of melting ice. Students will then work in pairs to discuss some introductory questions and share their thoughts (Think-Pair-Share):

Figure 3

Exploring Outer Space



Note: Own elaboration, made with Canva.

- What can you see?
- What is happening in this picture?
- Does this place look habitable?
- Is water easy to find here?
- Would you like to live in a place like this?
- Why is water important for life?
- Can humans survive without water?
- Which planet in our Solar System has conditions similar to Earth?
- What makes a planet habitable?
- Is Earth changing?
- Do some countries already have water problems?
- Could Earth become a desert planet?
- If Earth becomes uninhabitable, where could we go?
- What would we need to save a planet?
- What if there is a planet that has already experienced this crisis?

They will have a total of 10 minutes for this activity.

Over the next 10 minutes, students will be provided with the *Solar System Scope* app to observe the different parts of the planets and learn new vocabulary. This app offers a 3D view of the planets and the solar system. They will also be shown a NASA website that displays the solar system in real time and compares the sizes of the planets.

Once students have watched this, a Kahoot quiz will be conducted to assess their knowledge. This will also help them learn new vocabulary. Once they finish, they will be given an English vocabulary worksheet on the components of the planets and the space, which they can use in the next activity (Annex 3).

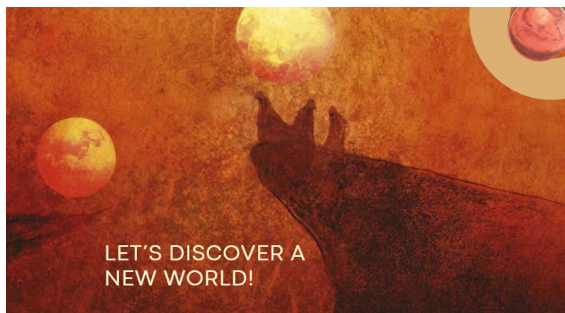
Finally, over the next 20 minutes, they will be given five different planets to each group to observe their diversity: Uranus, Earth, Mars, Jupiter, and Neptune. In these science worksheets, they will have to analyse basic information such as: the atmosphere, temperature, oxygen composition, rotation, and habitability (Annex 7). Then, in the final minutes, they will explain what they have found and check whether the information matches.

Second Session

In this second session, I will introduce the graphic novel *Dune* with the following objectives: visual inference, reading anticipation strategies, developing critical thinking, narrative competence, and emotional engagement.

Figure 4

Dune



Note: Own elaboration, made with Canva.

To this end, the first five minutes will be spent showing students images of the cover and the beginning of the novel, similar to the previous session. In small groups, they will analyse the cover and discuss their conclusions. As a guide, they will be provided with the following questions:

1. What can you see?
2. Where does the story take place?
3. Is water present?
4. Who lives here?
5. Who might the character be?
6. What problem could exist?
7. Is it safe or dangerous?

Building on the ideas discussed in the introduction, over the next 15–20 minutes, each group will receive a set of clues about the novel: illustrations of the characters and key phrases highlighting the planet’s water scarcity, the importance of spices, and the materials the natives use to survive (Annex 7).

Then, once the students receive the envelope with the characters, they will do a “Character Walk” (Annex 3). That is, using the information they gather, they will have to imagine the planet’s conditions (the climate, the landscape, the water), think about what role the characters might play just by looking at the image (whether they are heroes or villains, what their goal is), and consider the resources (what might be valuable, who controls them...). Then they will give a mini-presentation of the conclusions they have drawn. The goal is to foster critical thinking and encourage them to imagine the story, while also activating the use of relative pronouns and reported speech.

Once they have discussed the material and they have constructed part of the story, they will be provided with a summary of the story without detailing the events that occur, as it is expected that in the following sessions, they will build the story themselves:

In the future, humanity will live on many planets. One of them is Arrakis, a desert planet where water is extremely rare.

Arrakis is the only place in the universe where a mysterious substance named Spice exists. The spice is especially valuable because it allows space travel and gives special abilities as it prolongs life and enhances the cognitive abilities of those who consume it. Spice, known as Melange in the Dune universe, is a narcotic produced on

the planet Arrakis from the excretions of sandworms. The spice is considered a sign of wealth and social status, and control over it is crucial to the development of civilisation in the Dune universe. As a result, powerful families fight to control the planet.

A young boy called Paul Atreides arrives on Arrakis with his family. Soon, he discovers that surviving on this planet is very difficult. The people who live there have learned to adapt to extreme heat, sandstorms and lack of water. But Arrakis hides secrets, and human decisions may change the future of the planet forever.

Using this information, students will predict what will happen in the story in the last minutes of class. In small groups, they will create a storyboard in which they will write an alternative ending, a new conflict, or a destroyed planet. To do this, they will need to include a description of the planet, the characters they have been shown, a problem, and a prediction. Finally, they will briefly present their work.

Overall, the objective of this session is to foster an understanding of the planet Arrakis as an ecosystem and to introduce science fiction as a critical tool. Students discover *Dune* without a direct explanation.

Third Session

This session will review the knowledge gained throughout the course. To that end, the first 10 minutes will consist of some introductory questions to encourage student participation and help them recall what they have learned:

- Is Arrakis fiction or prediction?
- Do you think it has some similarities to the planet we saw before?
- Could Earth become Arrakis? Why?

Next, a brief overview will be provided of the characters introduced in the second session and their respective roles in the story. It would be presented in a very concise manner, since students will be playing these characters later on: Harkonnen, Fremen, Scientist, and Atreides.

Over the next 30 minutes, they will accomplish an activity in which four large groups will portray the families of *Dune*. The goal is for students to immerse themselves in the novel and form their own opinions on topics, such as politics and ecology. Additionally, they will understand how the environment shapes society, negotiate solutions, and apply grammatical structures in context.

To do this, each group will receive an envelope containing information about the families and how their characters should proceed. In other words, students will engage in a role-play, with each group representing a noble house (Annex 7).

Their mission is to consider how to improve the climate, find water, human adaptation, and societal and ethical issues. Additionally, they will be given a secret mission and lives they must maintain.

This activity represents a pedagogical scaffolding, where students engage in progressive learning and meaning-making.

It will be presented to them as follows:

- “Today, you will not only study Arrakis... You will try to survive it.”
- “You are now House leaders.”
- “Read your House identity. Do not share it and act according to your values.”
- “Each House has limited resources: Water, Energy, People.”
- “Your decisions will change them.”

There will be four different stations, which will rotate every 10 minutes. At each station, students will be given a task to complete in their own groups (Annex 3):

1. How do humans survive extreme heat?

Choose:

- If there were underground cities
- Special suits
- Migration to colder cities

- Other idea
2. How will your House control water in Arrakis?
 3. Invent human adaptation
 4. How would your House come to power?

In addition, the solutions they reach at each station will be interrupted by messages from Arrakis (“New situation on Arrakis. Attention Houses. New information from Arrakis”), which will determine whether they keep their resources or not. That is why the decisions they make will be important. To keep their characters alive, they will have to reach a consensus with other groups and form alliances; they will even be able to exchange resources. In this way, they will gradually come to understand what is happening in the graphic novel, as well as the importance of negotiating to reach a solution.

Finally, in the last few minutes, all the Houses will come together, and they will try to reach a consensus. The following questions would be asked:

- Was cooperation easy?
- Did power create conflict?
- Who really controlled Arrakis?
- Who should lead Arrakis?
- What system is best?

Only survive those who:

- Cooperates
- Respect the ecosystem

Fourth Session

In this fourth session, we will hold a *Dune*-themed escape room to practice English grammar and wrap up the story.

To do this, the session will begin with a message from Jessica, who will ask for their help in solving her family's problems. Based on the role-play we did earlier, students should already be able to imagine what has happened.

This time, they will be provided with comic strips so they can read and visualise the story, which will help them complete the exercises. To do this, students will be given four different worksheets, on which they will have to read the messages and rewrite them. At each station they pass through, they will receive a pin from each house and a piece of a puzzle, which they will later have to complete together (Annex 7). The stations are as follows:

Emergency transmission:

Agents!

Duke Leto ordered the rescue of spice workers before a sandworm attack, but field communications were fragmented. House Atreides needs a reconstructed commander's report.

Rewrite the official report using the key intelligence verbs: insisted, warned, explained, ordered, reported, and admitted.

Field testimonies:

- Leto: "We're not leaving any men for that monster."
- Pilot: "The worm is coming."
- Worker: "The carryall will rescue the crawler, the crew and the load of spice before the worm arrives."
- Technician: "The carryall is late."
- Leto: "Out! Now! This is a command from your Duke!"
- The crew: "We are ready to evacuate."
- The Imperial Scientist: "A leader such as that would command fanatic loyalty. He would be difficult to defeat."

Security identification system:

Agents!

After the attack, Atreides Intelligence must identify allies and enemies. Security records are incomplete. Combine the information to create a security message, identifying each person or place.

- Paul is the boy. He escaped the attack.
- Jessica is the woman. She protects Paul.
- The palace is the place. The betrayal happened there.
- The soldiers are enemies. They follow the Baron.
- Duncan Idaho is the warrior. He helps them escape.
- The room is dangerous. Leto was captured there.

Harkonnen interrogation:

Agents!

The Harkonnen have not yet discovered what happened to Paul and Jessica. Your task is to predict what enemy interrogators might ask and prepare survival information.

Create an interrogation summary with possible questions the Harkonnen would ask. Then report them as intelligence notes.

Fremen knowledge trial:

Agents!

Paul has begun to understand Arrakis, but he and Jessica must gain the trust of the Fremen.

Send a survival message to Paul and Jessica.

Explain:

- How they should approach the Fremen
- What they must do

- What they should avoid

With this *Dune* theme, students are expected to use reported speech and relative pronouns, allowing them not only to engage with the story, but also to work on their grammar and vocabulary. Additionally, they will apply reading comprehension skills using excerpts from the graphic novel and solve cooperative challenges.

By the time they complete the final piece of the puzzle, they will have read and deciphered the most important parts of this first volume of the graphic novel. Finally, in each session, through the activities and images provided, they will have gradually built the story.

Fifth/Sixth Session

In this final English session, students will create their final project: a presentation. Drawing on all the information learned in previous sessions and the final project completed in biology class, students will take on the role of influencers selected for a social media campaign. They will advocate for a sustainable planet, the eco-friendly decisions they have made and the influence of *Dune* on their thinking, applying their scientific knowledge. These oral presentations will be given individually, with each student speaking for about three minutes. To do so, they will use a template created by Canva.

3.3.2. Biology Sessions

As mentioned before, Arrakis is a good example of the topics that will be covered, as it represents an extreme ecosystem where students can observe desertification, water scarcity, extreme temperatures, and the survival of organisms.

While the various sessions are conducted in English, students will receive an explanation of the curriculum on the planets and the solar system in Spanish during Biology class. Additionally, while these sessions are taking place in English, students will be assigned a task to upload to the Biology Padlet.

First, after the initial English session, students will be asked to upload a news article about climate change. In this way, they will write a brief reflection in English explaining what the article is about and sharing their opinion.

Once the third *Dune* session is over, they will be given the second assignment, since they now understand how Arrakis works. Therefore, students will be asked to discuss ways to survive on Arrakis, a planet where water and resources are scarce, and temperatures are extremely high.

Finally, their third mission will be to create a habitable planet or choose one from the solar system. This will require two to three sessions during which they will create their final product: a model. For this model, they will use materials they bring from home.

Once this task is complete, they will upload a 30-second audio clip reflecting on the three tasks they have completed and what they have learned in the process. Next, they will give a presentation in Spanish explaining the three missions and the materials used for the models.

The objectives of these missions are for students to connect fiction and reality, develop critical environmental thinking, analyse planetary sustainability, and understand the science behind *Dune*. The missions on the Padlet extend learning beyond the classroom, fostering student autonomy, the functional use of English, and the narrative connection between *Dune* and real-world issues linked to the SDGs.

Moreover, the Padlet serves as a tool for formative assessment, asynchronous learning, evidence of competency, monitoring of PBL, and preparation for the final product.

Ultimately, through the final products, students will be able to understand climate change, learn about the importance of a planet's habitability, use English for real-world purposes, and develop critical thinking skills. In this way, students not only experience a complete narrative journey but also deepen their reflections through the connected activities.

3.4. Methodology

The approach used to carry out the activities throughout the sessions outlined here, aligns with the objectives described above, in which students will be asked to demonstrate their prior knowledge and concepts as they work on different thematic units. Thus, following a collaborative session of a more “theoretical” nature, activities will be developed, in which students apply their newly acquired knowledge, linking one activity to the next and alternating between group and individual activities.

To conduct this project, various methodologies mentioned in the theoretical framework were used: Project-Based Learning focused on a final product, gamification, cooperative learning, experiential learning, and an educational escape room, as well as the use of digital tools, including Padlet, to integrate the graphic novel.

Additionally, the Canva platform was used to create materials serving as visual aids for the classes, acting as a tool to structure the discourse that would extend beyond the activities.

Students accessed the materials through printed worksheets covering different parts of the graphic novel. Annex 5 includes some photographs of the students during some of the sessions.

In addition, a qualitative approach will be used to analyse the results of this project, focusing on students' comments and reactions during each session. A focus group will also be conducted to gather feedback from the participating teachers.

4. Results

4.1. Observations in the classroom

As mentioned earlier, since this is a series of activities in which equal weight is given to both the final product and classroom participation and attitude, assessment is based on a qualitative approach; that is, evidence is gathered through observation of students' attitude and participation, as well as the activities carried out in each session.

Through classroom observations, students have demonstrated a growing interest in the various sessions, although it was initially difficult to capture their attention. In the first session, the interactive whiteboard was used to project a presentation. Before starting, I briefly explained what the project was about, the activities we would be doing, and the ultimate goal of the Promised project. At first, they struggled to participate, but they gradually began to speak up more. Later, I tried to open the NASA and *Solar System Scope* apps to work on vocabulary, but the screen was not working. Some students tried to help me, but we were not able to get it to display. In the end, after about five minutes of trying, we decided to move on to Kahoot. There was a high level of interest in this activity, and it went very well, as all the students present were engaged and motivated. Finally, they did the scientific worksheets in another class, as we had no time, and they showed a great interest in them.

Additionally, some students used the *Solar System Scope* app, which I had trouble displaying in the previous session.

In the second session, there was slightly more interest than in the previous session. In addition, during the character walk and storyboard activities, the students began to apply more critical thinking and felt more at ease. There was not enough time for everyone to present their storyboards, but some of them were very creative. Moreover, some students commented that they liked this part of the activities best.

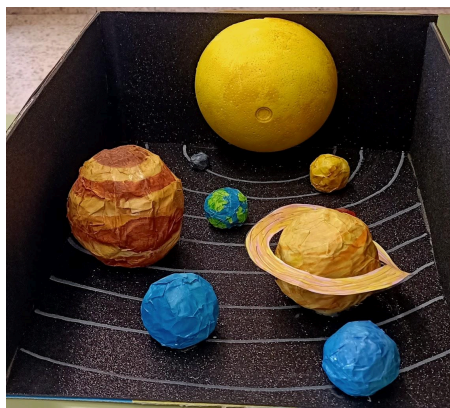
In the third session, the students showed a high level of motivation. After the initial explanation of what the activity entailed, the students began responding on their own, participated actively in the groups, and engaged in conversation with their classmates. They embraced their roles from the very first minute. At the end of the class, most students told me they had loved this activity and would like to use it at summer camps.

In the last session, there were only 12 students, so it was easier to carry out the activities. The students answered the proposed activities correctly. Finally, putting together the final puzzle was what they liked best. However, their enthusiasm was somewhat lower than in the third session.

On the other hand, in the biology sessions, the students also showed great interest in building the model, as they had the opportunity to work in groups and create something of their own. Moreover, the use of Padlet helped them to explore further the different themes that we were working on.

Figure 5

The Solar System



Note: Created by the students

Finally, the teachers who attended the various sessions also noted that the students showed greater interest in them. Although there were 28 students and it was somewhat difficult to get everyone to participate or speak English during the different activities, the teachers could see the students' interest in the classes reflected in the final presentations, both in biology and English classes. These presentations demonstrated a great deal of effort put into the project, along with thoughtful reflections.

Overall, the various activities not only revealed an increasing motivation in students, but also a deeper understanding of the content and more sophisticated reflections. Through classroom observation, and considering the missions they completed on Padlet and their final presentations, we observed that students improved in their critical thinking and the solutions proposed regarding climate awareness. In the first mission, they provide their opinion on the article found. In the final reflection, they presented more sophisticated reflections and solutions for the problems that our planet faces.

4.2. Evaluation

The learning activity took place in two fourth-grade ESO bilingual classrooms: 4°C/E and 4° C. The first class has a total of 13 students, and the second one, a total of 15 students. However, some students did not take biology, so they did not participate in the final project, although they did take part in the activities conducted in the English classroom. There was also one student with special needs, though he participated equally in all activities with the help of his classmates.

Regarding the assessed materials, the final product consists of a final oral presentation in English and Spanish. Some evaluations were made regarding the answers given to comprehension questions, which demonstrate progress in the teaching-learning process. This was evident in the final oral presentation on the project.

Additionally, the worksheets completed during the various sessions were taken into account to assess the students' performance over time, as well as the use of the Padlet. Hence, data was collected through classroom observations regarding students' attitude, participation, and the time spent on activities, as reflected in the worksheets completed in class.

Regarding the rubric, it was developed based on the Key Competencies of the Graduate Profile established by the LOMLOE (2020), which were used as a reference for its

development. It is assumed that plurilingual competence is acquired across all sessions in an integrated manner.

The following details the rubric that has been developed for the final assessment of presentations. The first table has been taken into account for the final English presentations, and the second one for the Padlet assignment and the final Biology presentation:

Table 1

Oral Presentation: Assessment rubric

Criteria		4 (Excellent)	3 (Good)	2 (Basic information)	1 Needs improvement
Scientific knowledge of the planet (20%)	Designs a habitable planet by applying scientific knowledge and Explains the planet's conditions	Clear, scientific explanation related to habitability	Accurate, with minor errors	Basic information	Difficult to understand
	Relationship between climate, life, atmosphere, natural resources, and sustainability	Analyses consequences and solutions	Partial relationship	Mentions without explaining	Does not establish a relationship
Sustainability and environmental awareness (20%)	Climate awareness	Clear and critic message	Message present	Underdeveloped	There is no message
	Proposes sustainable solutions	Realistic and creative solutions	Some solutions	General ideas	No proposals
Transfer of Learning: Dune (25%)	Arrakis-Earth comparison	An in-depth and thoughtful comparison	Correct comparison	Brief mention	No connection

	Social/ecological reflection	Analysis of humans decisions	Basic reflection	No clear	There is no reflection
Scientific communication in English (15%)	Good use of English	Fluent and clear, with proper grammar	Understandable, despite the errors	Very guided	Difficult comprehension
	Scientific vocabulary	Variety and precision	Adequate	Basic	Very limited
Communication and final product design (20%)	Creativity and design	Very attractive and professional	Clear and organised	Simple	Not very developed
	Adaptation to the audience	Persuasive message	Comprehensible	Unattractive	Confusing
	Content organization	Excellent coordination	Good	Regular	Disorganised

Note: Elaboration based on the Specific Competences of the LOMLOE, 2020.

Table 2

Padlet rubric and Final Presentation: Scientific Objectives in Biology

Mission 1 (Climate Change article) (15%)	Mission 2 (How to survive in Arrakis) (15%)	Mission 3 (Create a habitable planet or choose one of the Solar System) (20%)	Reflection (20%)	Final Presentation (30%)
SC 2.1	SC 2/3	SC 6.2	SC5	SC6

Note: Elaboration based on the Specific Competences of the LOMLOE, 2020.

As mentioned earlier, the assessment of the projects took into account the activities on Padlet, the final presentations, and classroom observations. For both activities, the results were recorded using the two rubrics provided. In the English course, the assessment focused on oral expression, the content covered from *Dune*, and the students' ability to apply critical thinking. In biology, however, the students' ability to reflect on the three missions and the models they created was taken into account.

Finally, the final results of the presentations in both subjects show that a large portion of the students followed the proposed materials and correctly understood all the different parts. In the English class, students understood the content and followed the lessons from *Dune*, as

reflected in their final oral presentations (Annex 2). The entire 4C/E class fully understood all the activities. In contrast, the other 4C class showed somewhat less interest and engagement in the proposed activities, although the expected results remain positive.

Likewise, for their projects, they used the materials covered in class. Furthermore, their reflections on climate change and sustainability were reflected in a wide range of resources. However, some of the students did not demonstrate a clear understanding of the activities, so the final results consisted only of very basic reflections.

5. Conclusions

5.1. Analysis and Challenges of the Project

The development of the learning situation has demonstrated how an active, interdisciplinary methodological approach is effective in fostering active participation, critical thinking, and student engagement with current issues. Both groups have shown a high level of interest thanks to the contextualisation of the problem within a setting close to their own lives. This, combined with the use of comics as a learning tool, has contributed to a high level of participation, due to their visual and narrative nature, which is directly related to their everyday cultural codes, as evidenced by the high level of engagement demonstrated by all of them. Moreover, the advantage of using comics as a learning tool has been evident in their ability to connect with scientific and environmental concepts in an accessible and engaging way. Thus, it has not only enabled the delivery of curricular content, but, due to its own narrative complexity, has also allowed for connecting it to profound reflections on the role they play as individuals and we as a society in addressing major global challenges, as well as the context in which we live.

In terms of the final product and evidence of learning, a gradual improvement was observed in the students' responses, with particular emphasis on those that linked the content of the graphic novel to current reality. Likewise, the activities related to creating a final model also yielded positive results in terms of creativity and the ability to synthesise information.

In order to provide a more structured evaluation of the implementation, the following synthesis relates the general and specific objectives established in section 1.3 with the outcomes observed throughout the development of the proposal. This assessment is based on

classroom observation, students' production and the evidence collected during the different sessions:

Table 3

Level of achievement of the Objectives

Objectives	Degree of achievement (1-5)	Evidence
Promote interdisciplinary learning integrating scientific knowledge, English communication skills and eco-social awareness.	5	Effective integration of English and Biology, reflected in final projects combining language use, scientific knowledge and sustainability.
Develop communicative competence in English	5	Improvement in oral presentations and use of specific vocabulary, though with uneven fluency across students
Foster critical thinking through environmental and social issues	4	Evident in discussions and role-play activities, but not consistently developed in all learners
Promote environmental awareness and civic responsibility (SDGs)	4	Strong reflections observed in Padlet tasks and final projects
Apply active methodologies based on cooperation, research and creativity	5	High level of engagement in role-play, escape room and collaborative activities
Integrate digital tools as means of communication and reflection	5	Effective use of Padlet and Canva in different stages of the project
Develop autonomy, initiative and responsible decision-making	4	Active participation and collaboration in group tasks and problem-solving situation

Note: Own elaboration

In summary, it is necessary to critically evaluate all aspects observed both in the classroom and in the execution of the final products. In this regard, the following elements are assessed:

- Students showed interest in the vast majority of activities, demonstrating a high degree of engagement.
- Participation was high in various sessions, during which students offered interesting reflections and even proposed solutions to the questions posed.

- Many of the activities fostered students' creativity. This is particularly evident in the final products created. In addition, the implementation of various missions on Padlet helped students engage in reflection.

However, although the project was successfully implemented, some sessions encountered difficulties due to time constraints or malfunctions with the digital screens:

During the first session, we were unable to demonstrate the *Solar System Scope* app and the NASA website because the digital screen would not display them. Despite trying for a while, we were unable to show it. Additionally, the class was originally planned to end with the science worksheet, but with only five minutes left, they were unable to complete it. Therefore, it was decided to complete the worksheet in the next biology class for students to practice their English vocabulary.

In the second session, there was not enough time for all the students to present their storyboards, although, overall, based on the observations, the children developed very creative stories.

On the other hand, in the fourth session, in the escape room, there were some difficulties, since although the number of students was smaller, we could not move the student with special needs. Therefore, when it came time to rotate, some cards got mixed up, and they were unable to follow the story correctly.

Finally, despite these difficulties, the results obtained are very satisfactory, demonstrating that the use of graphic novels through various activities can help teach different content.

5.2. *Proposals for improvement*

Although the initiative has generally been successful, certain aspects could be improved, and that should be taken into account for future implementations to refine the planning and better adapt it to classroom conditions.

Regarding the duration of the sessions, it was observed that discrepancies occurred in some cases. In some sessions, there was enough time to complete all the activities in class, while in others—due to issues with the digital screen or more extensive student discussion—the time to complete the activities ended up being insufficient, resulting in some

exercises remaining unfinished or requiring another session. Consequently, it would be advisable to check in advance whether the screens are working or to plan more flexible activities to ensure that each session can be fully carried out.

Furthermore, the limited time available to prepare the sessions, combined with the diversity of perspectives among the teachers involved, made it challenging to implement as originally planned. Therefore, for future implementation, ongoing communication and coordination could help facilitate a more effective adaptation of materials and sessions.

5.3. Final reflection

Overall, the assessment is positive and provides a valuable foundation for future applications. This approach has successfully integrated science fiction with real-world issues affecting the present, fostering critical thinking through a creative lens that has transformed the classroom into a space that is not only a cradle of knowledge but also generates it based on students' interests and abilities.

The interdisciplinary and competency-based approach has proven to be an effective way to address curriculum content in English and Biology, while fostering awareness and action regarding sustainable development and the climate emergency. Furthermore, the project has demonstrated the value of working from a critical perspective in the classroom, where the use of graphic novels and the planets has fostered not only motivation and language skills but also climate awareness.

Despite occasional challenges in managing the work and using digital tools, the viability of the approach adopted has been confirmed by the positive reception and results it has yielded. One of the most notable aspects of this project is the ability to foster critical thinking. The results indicate positive progress among most students and a high degree of transfer of the content covered, related to the specific and general objectives. Consequently, this experience reinforces the need to commit to active and contextualised teaching, with new implementations that help motivate and improve student performance.

In short, the initiative has achieved its main objective: to provide an innovative, motivating educational experience aligned with the interests of today's society.

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7. Annexes

7.1. ANNEX I: Sostenibilización curricular

Titulación: Máster Universitario en Profesor de Educación Secundaria Obligatoria y Bachillerato, Formación Profesional y Enseñanza de Idiomas
Apellidos y nombre alumno/a: Muñoz Palacio, Nerea
Título del trabajo: OUTER SPACE THROUGH THE GRAPHIC NOVEL <i>DUNE</i> : A CLIL Didactic Proposal for Secondary Education
Apellidos y nombre tutor/a: Ruiz Hidalgo. David

Reflexión sobre los aspectos de la sostenibilidad que se abordan en el trabajo
This work aligns with Sustainability Goals, as the overall project addresses issues such as water scarcity, climate change, and sustainability. Through the narrative of the graphic novel <i>Dune</i>, which explores themes such as water scarcity and desertification, as well as the central theme of the planets, it has helped to deepen eco-social awareness and the ability to propose sustainable solutions. Thus, from a critical, reflective, and active perspective, sustainability has been a key component of the PROMISED project, with an explicit presence in the tasks, methodological approach, and evaluation. In fact, the 2030 Agenda for Sustainable Development was taken into account in the project's planning and implementation. Through various activities, three main sustainability goals were addressed: ● Sustainable Development Goal 6: Clean Water and Sanitation

- Sustainable Development Goal 13: Climate Action
- Sustainable Development Goal 15: Life on Land

As mentioned in the recent paper, the novel *Dune* addresses the themes of water scarcity, the importance of life on the planet, and the importance of driving change. For this reason, as a final project, the students prepared an oral presentation in which they not only reflected on the novel but also shared their views on the importance of climate change. Additionally, through a reflection, they were asked to propose solutions for potential improvement. This exercise not only fostered critical thinking among the students but also helped them apply their ideas to real-life situations. As inhabitants of this planet, we have a responsibility toward its resources, and this concept has been emphasised from the very first sessions. In this way, the students become active participants in their own learning.

Although the students have not taken any concrete action, they have proposed ideas that can be implemented in various areas of life, such as installing solar panels, “building homes adapted to outdoor temperatures,” or even “avoiding the use of synthetic clothing at home,” since it can harm the environment. In addition, they have explored important topics, such as the need to protect our atmosphere.

In the first mission, which consisted of searching for a new article, they had to research climate change and its impact on the planet. They found that even more satellites are being launched into space, which also contributes to climate change, as well as the scarcity of water in some countries. Furthermore, the topic of desertification was present throughout all the activities, as the planet in the graphic novel deals with this issue. Therefore, the students related this to ideas for surviving on a planet with these conditions, or gave examples of how to preserve what we already have.

On the other hand, one of the activities, which involved role-play, is related to Sustainable Development Goal 17. Since the students had to reach a consensus on how the government and its citizens could preserve the planet, they provided examples of the importance of technology and science. One of the solutions they proposed was the use of solar panels, which could be linked to Goal 7.

Finally, we could say that this project aligns with sustainability goals, as the various activities have allowed us to explore different aspects of climate change through the themes of planets and *Dune*. Progress among the students is evident, as the assignments they have been given reveal a deepening of their reflections, in which they have discussed solutions to real-world problems. Furthermore, the work has taken place in an inclusive and equitable environment, where democratic and sustainable discussions have been held.

7.2. ANNEX II: Evaluation

Table 4

4th ESO C/E Evaluation

Scientific knowledge of the planet (20%)	Sustainability and environmental awareness (20%)	Transfer of Learning: <i>Dune</i> (25%)	Scientific communication in English (15%)	Communication and final product design (20%)	/20	/100
4	3	3	4	3	17	8,5
4	4	4	3	3	18	9
4	3	3	3	3	16	8
4	3	3	3	4	17	8,5
4	4	4	3	3	18	9
4	3	3	3	3	16	8
4	4	3	4	3	18	9
4	3	3	3	3	16	8

Table 5

4th ESO C Evaluation

Scientific knowledge of the planet (20%)	Sustainability and environmental awareness (20%)	Transfer of Learning: <i>Dune</i> (25%)	Scientific communication in English (15%)	Communication and final product design (20%)	/20	/100
4	2	3	3	3	15	7,5
3	3	3	3	3	15	7,5
4	3	3	3	4	17	8,5
4	2	2	3	3	14	7

Scientific knowledge of the planet (20%)	Sustainability and environmental awareness (20%)	Transfer of Learning: <i>Dune</i> (25%)	Scientific communication in English (15%)	Communication and final product design (20%)	/20	/100
4	2	3	3	3	15	7,5
4	4	3	3	4	18	9
4	2	3	3	2	14	7
4	4	4	4	4	20	10
4	4	4	3	3	18	9
4	4	3	3	4	18	9
3	4	4	3	3	17	8,5
3	3	3	3	4	16	8
4	3	2	3	3	15	7,5
3	3	3	3	3	15	7,5

Note: Some students were not present in the presentations, so I did not evaluate them.

Table 6

Padlet and Biology Evaluation

Mission 1 (Climate Change article) (%15)	Mission 2 (How to survive in Arrakis) (%15)	Mission 3 (Create a habitable planet or choose one of the Solar System) (%20)	Reflection (%20)	Final Presentation (%30)	/10
1	1.2	2	1.5	2.5	8,2
1.5	1.5	2	2	3	10
1	1	2	1.2	1.8	7
1.5	1.5	2	2	3	10
1	1	2	1.5	2	8.5
-	-	2	1.3	2	5.3
-	-	2	1.5	1.5	5
1.2	1	2	-	2	6.2
1.5	1.2	2	1.5	2	8.2
0.8	1.2	2	2	2.5	8.5
1.5	1.5	2	2	2.5	9.5

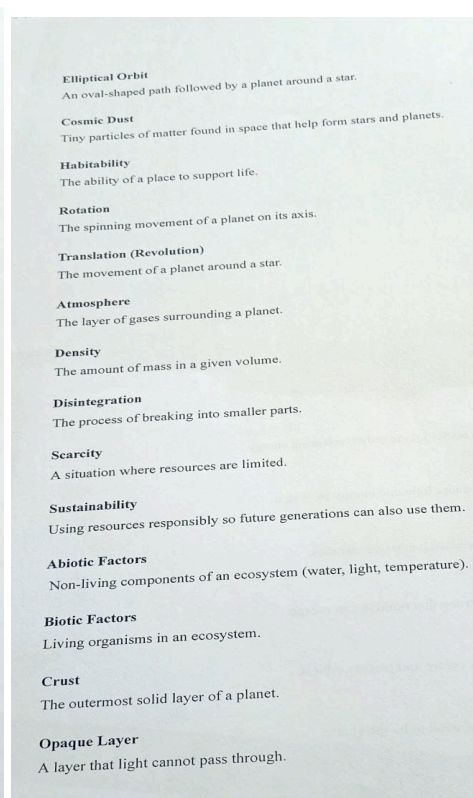
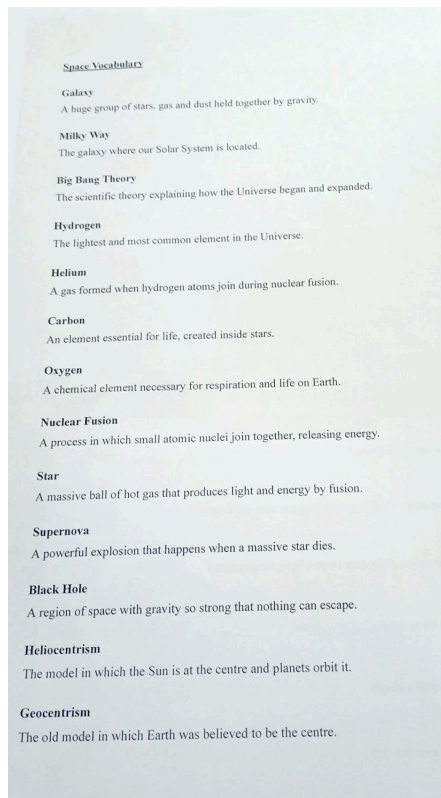
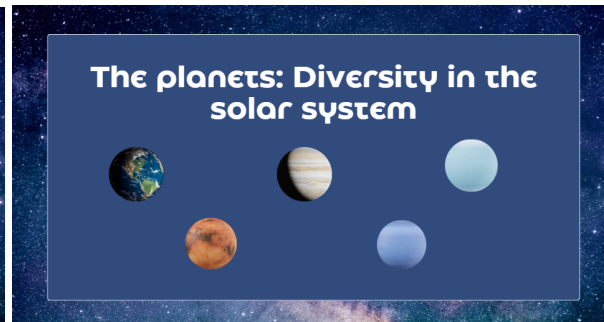
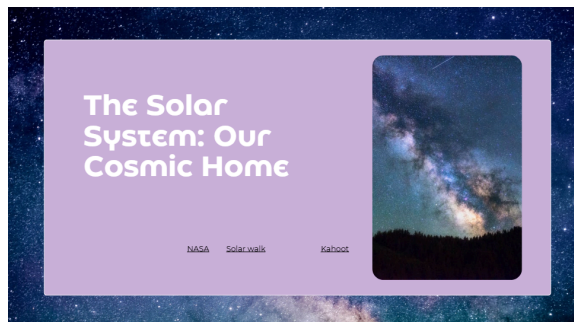
Mission 1 (Climate Change article) (%15)	Mission 2 (How to survive in Arrakis) (%15)	Mission 3 (Create a habitable planet or choose one of the Solar System) (%20)	Reflection (%20)	Final Presentation (%30)	/10
1	1.2	2	1.5	2.5	8,2
-	-	2	2	3	7
1	1.5	2	2	2	8.5
-	-	2	1.5	2.5	6
-	0.8	2	1.8	2	6.6
1.3	1.2	2	2	2.5	9
0.6	0.6	2	1.5	1.5	6.2
1.2	1.2	2	2	2	8.4
-	1	2	2	2	7
0.7	-	2	-	2.5	5.2
-	-	2	2	2	6

Note: These are the grades I gave; the biology teacher gave them based on what she considered appropriate.

7.3. ANNEX III: CANVA SLIDES

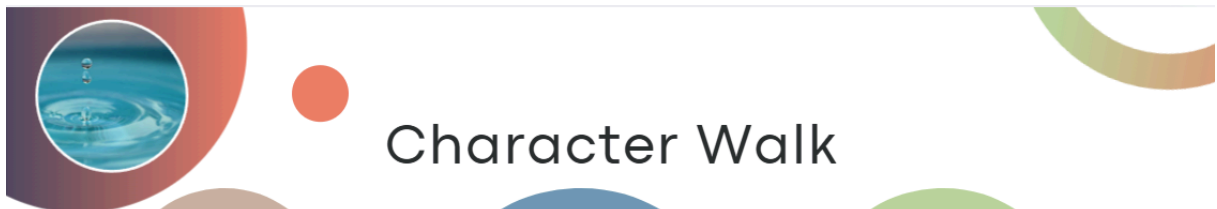
Session 1:





Session 2:





Planet

- Climate
- Landscape

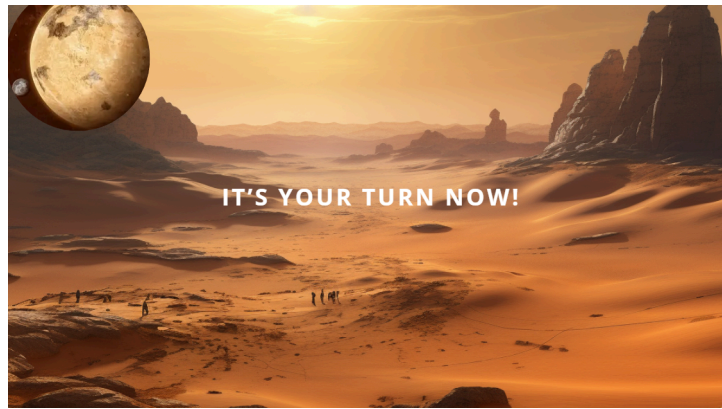
Characters

- Who is this character?
- What is their role? Find a character **who** looks powerful
- Are they heroes or villains?
- What do they want? Choose a character **who** might have secrets?

Resources

- What is valuable here?
- Who controls it?

WHAT IS THE STORY ABOUT?



WHAT WILL HAPPEN NEXT?

In groups you can draw a storyboard with:

- an alternate ending
- a new conflict
- a planet saved or destroyed

You must include:

- Planet description
- Characters
- Main problem
- Prediction

Session 3:

DO YOU INTEND TO CONTINUE PLANTING IT IN PEOPLE'S FACES, MY LORD?

WE INTEND TO KEEP THE CONSERVATORY, CERTAINLY, BUT ONLY TO HOLD IT IN TRUST FOR THE PEOPLE OF ARRAKIS.

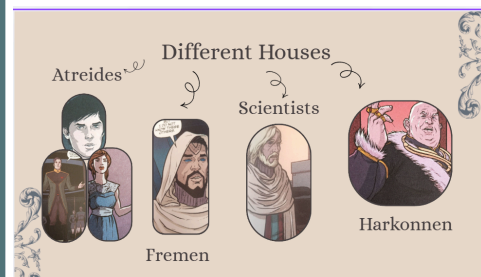
IT IS OUR DREAM THAT SOMEDAY THE CLIMATE OF ARRAKIS MAY BE CHANGED SUFFICIENTLY TO GROW SUCH PLANTS ANYWHERE IN THE OPEN.

HAS ANYONE EVER WALKED OUT OF THE DESERT?

NOT FROM THE DEEP DESERT SINCE PAUL WALKED OUT OF THE SECOND ZONE REVIVAL.

WE NEED A SOLID AND PERMANENT PLANETARY BASE HERE AND THAT HAS TO BE ON THE FREMEN.

ON CALADAN WE HAD SEA AND AIR POWER. HERE WE MUST DEVELOP DESERT POWER.



STATION 1

How do humans survive extreme heat?

Choose:

- if there would be underground cities
- special suits
- migration to colder cities
- Other idea

ATTENTION!

A massive sandstorm destroys surface structures.

Underground cities YOU ARE SAFE!

BUT...

Surface cities.... you lose your resources. As a consequence, -1 ⚡

STATION 2

How will your House control water in Arrakis?

ATTENTION!

Water reserves are critically low.

Each House must pay -1 💧

If you cannot ... you must negotiate or borrow

STATION 3

Invent human adaptation

ATTENTION!

Advanced technology stops working.

- Scientists lose their lead
- Fremen are gaining value.

So... Imperial Scientists you lose -1 ⚡

STATION 4

How would your House come to power?

ATTENTION!

People of Arrakis are protesting.

Why are citizens unhappy?

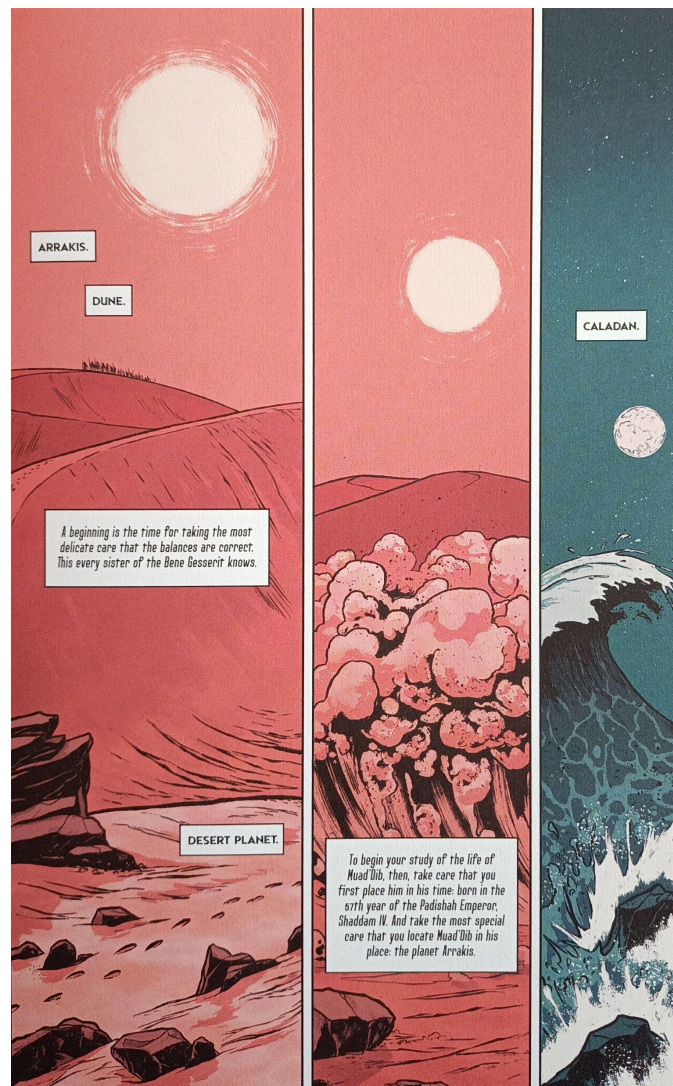
You need to cooperate. If not...

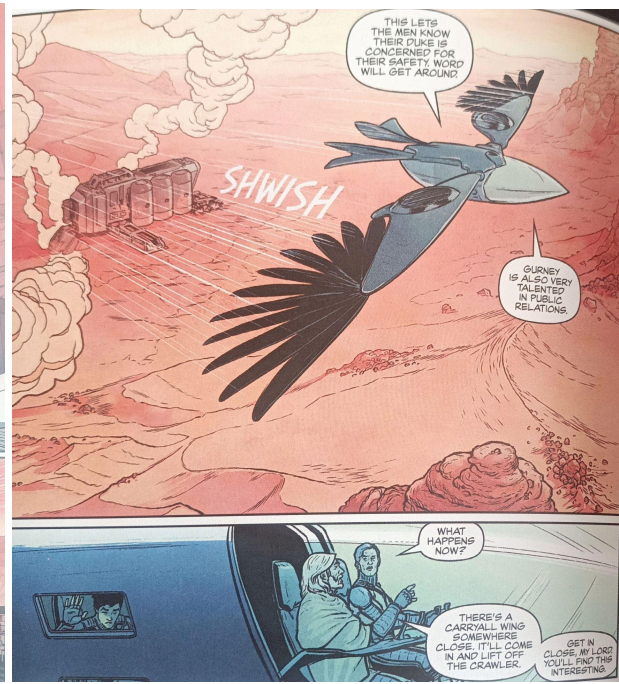
- The House with least cooperation loses -1 👥

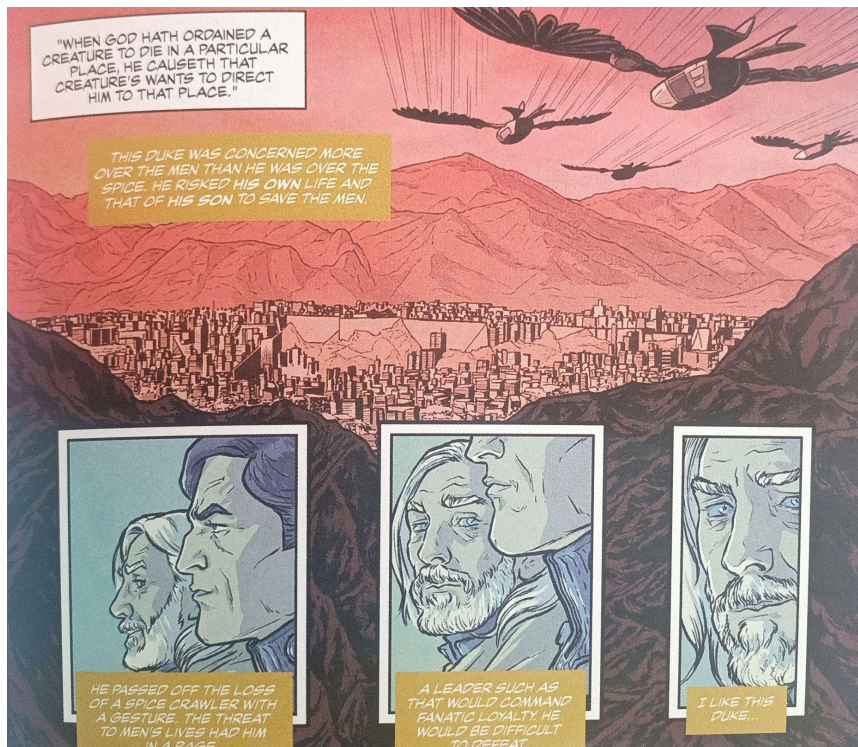
Final Council!

Who should lead Arrakis?

7.4. ANNEX IV: GRAPHIC NOVEL VIGNETTES









LATER THAT NIGHT...

A FREMEN MESSENGER
DELIVERED THIS NOTE TO THE
OUTER GUARD JUST AS I ARRIVED
FROM THE COMMAND POST...



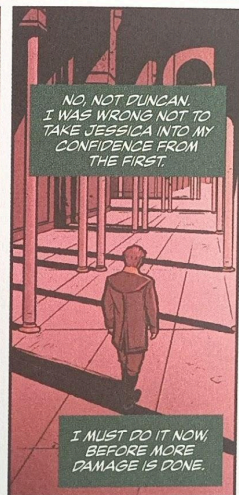
*A column
of smoke by
day, a pillar
of fire by
night*

WHAT DOES IT MEAN?
I'LL SHOW THE NOTE
TO HAWAT AS SOON
AS I SEE HIM.



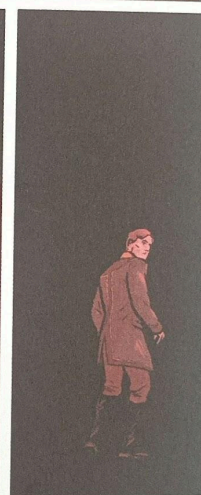
SHOULD I WAKEN
JESSICA? THERE'S NO
REASON TO PLAY THE
SECRECY GAME WITH
HER ANY LONGER.

BLAST AND DAMN
THAT DUNCAN
IDAHO!



NO, NOT DUNCAN.
I WAS WRONG NOT TO
TAKE JESSICA INTO MY
CONFIDENCE FROM
THE FIRST.

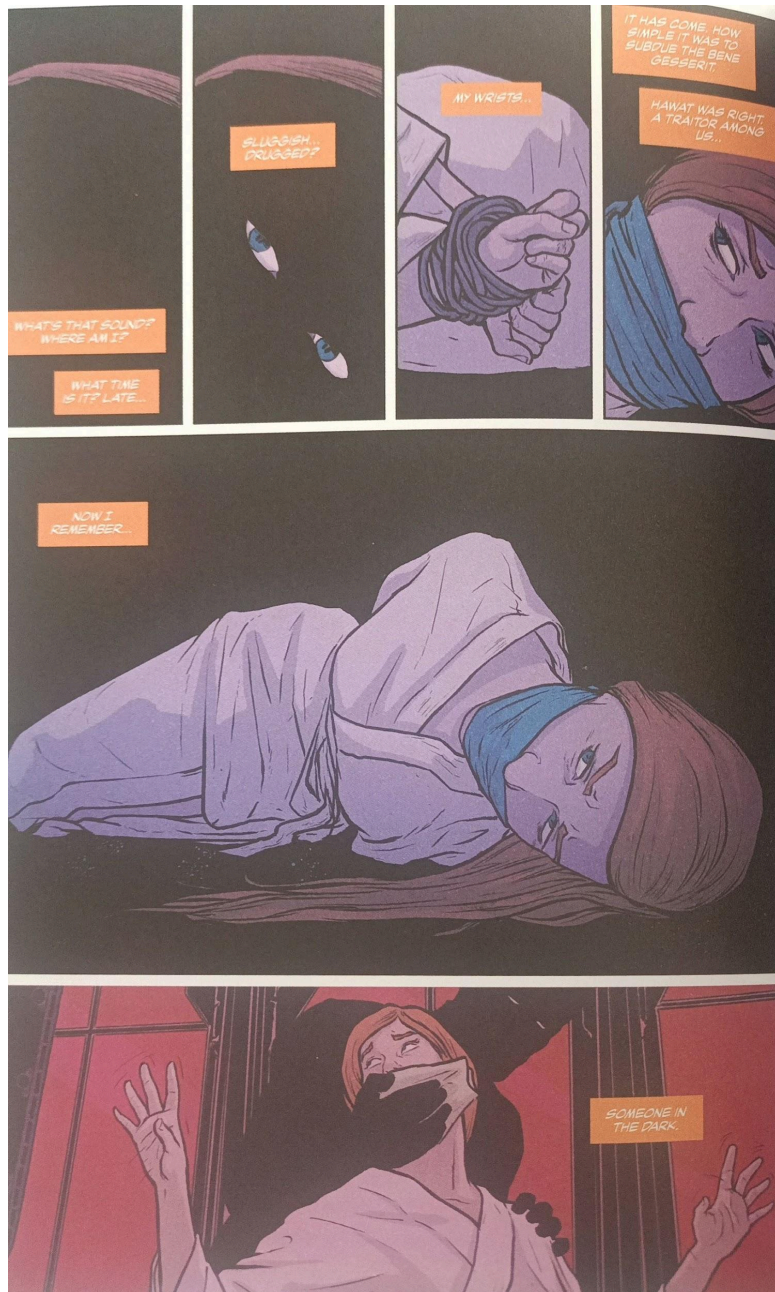
I MUST DO IT NOW,
BEFORE MORE
DAMAGE IS DONE.



















THE BATTLE CONTINUES,
BUT SOON ARRAKEEN
WILL FALL.

HARKONNEN
COMMAND SHIP.

THEN I CAN MOVE INTO
THE RESIDENCY, RATHER THAN
THIS LAMPED LIGHTER AS
MY COMMAND CENTER.

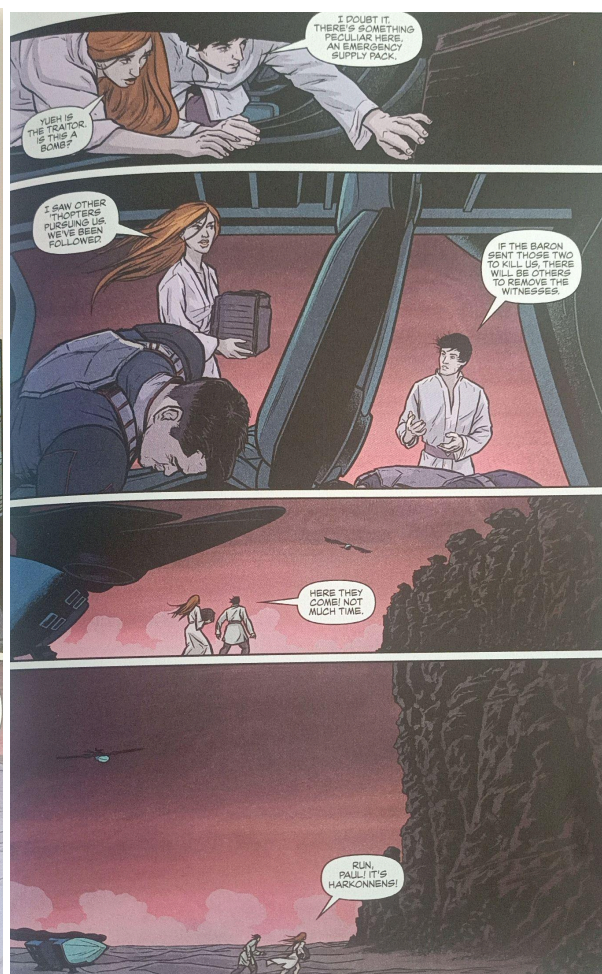


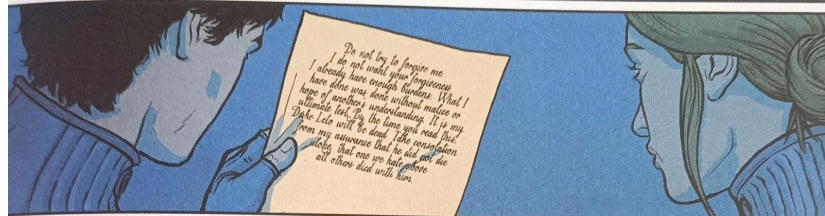
MY OWN HARKONNEN TROOPS,
AS WELL AS THE CRACK
IMPERIAL SARGAUKAR IN
MY HOUSE LIVERY.

THE ATREIDES WON'T
STAND A CHANCE.



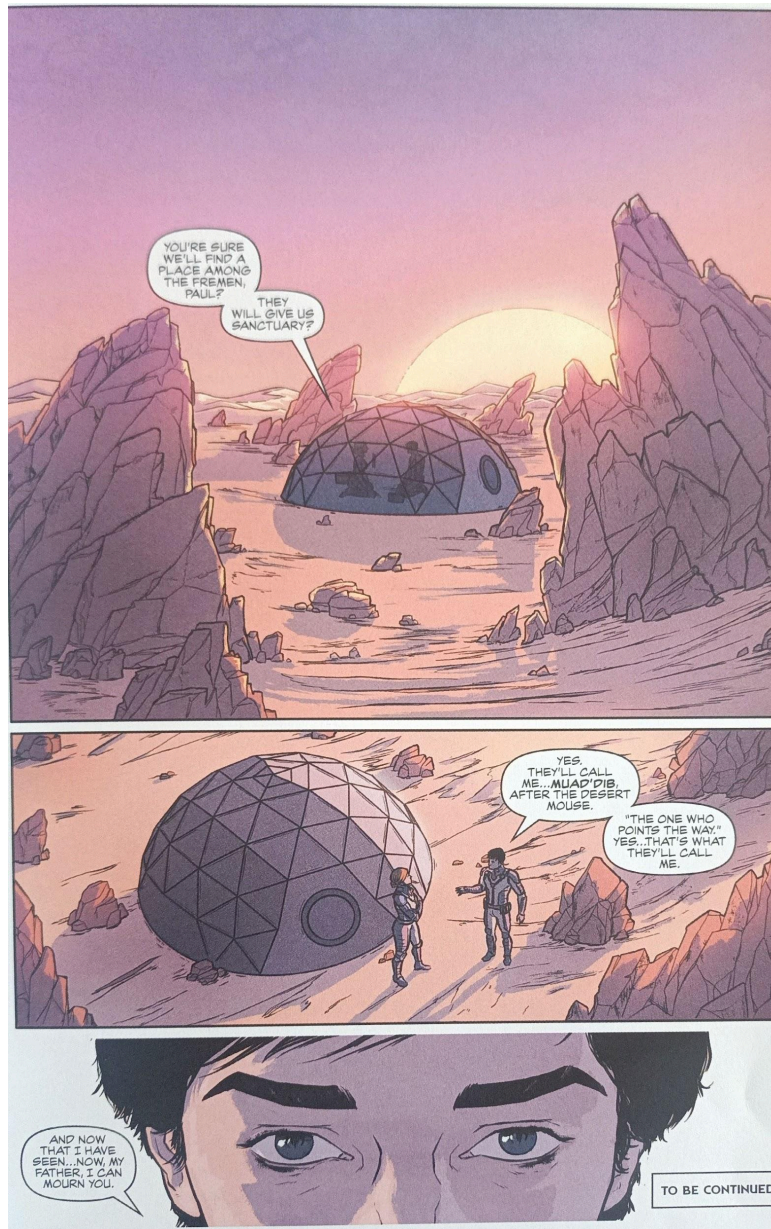
THE DUKE'S
ALREADY DEAD,
IF YOU MUST
KNOW.





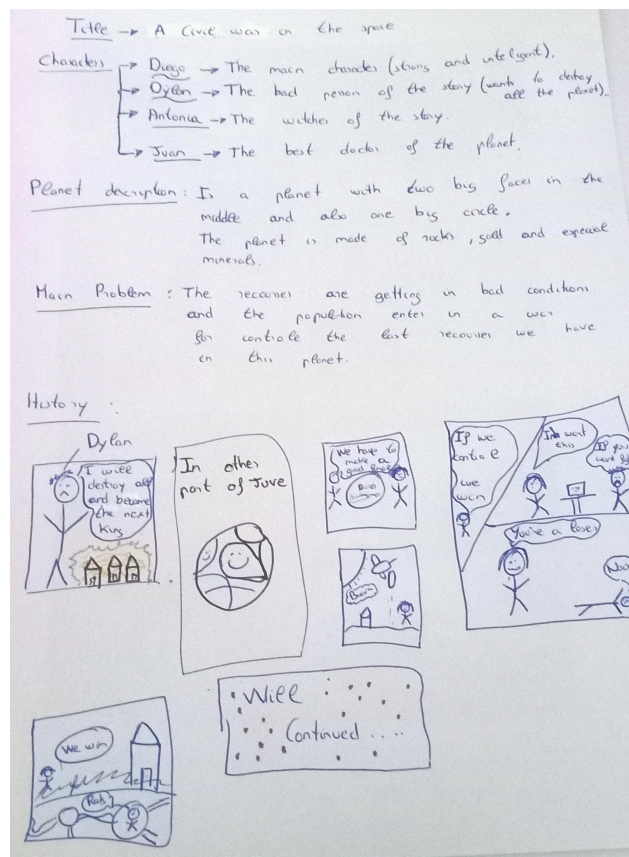
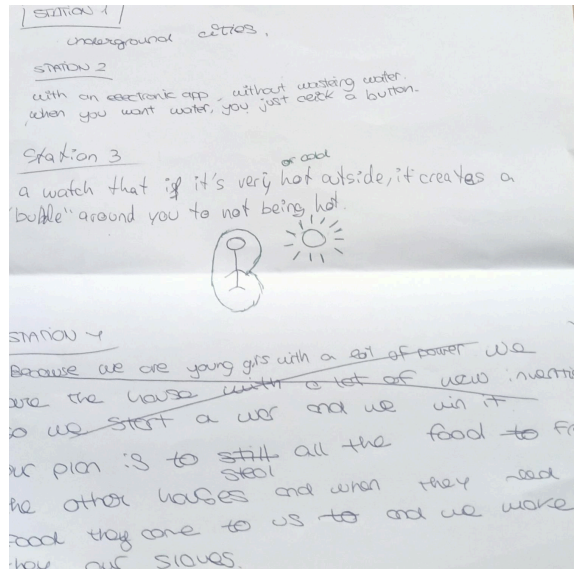




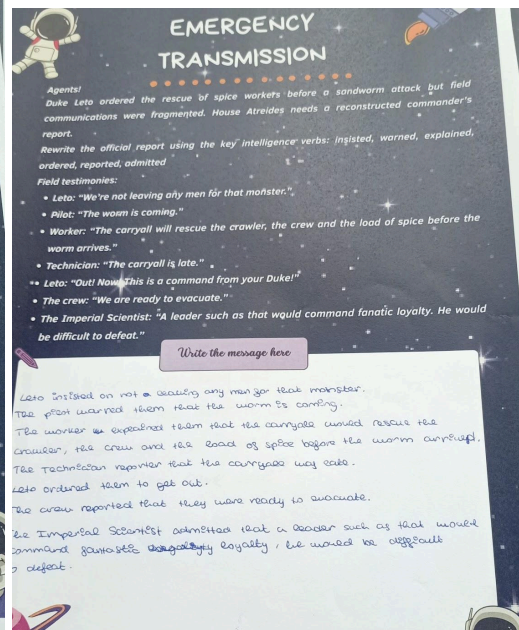
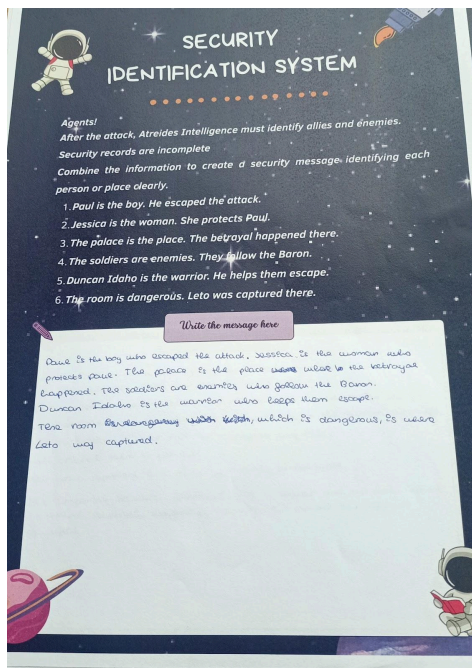
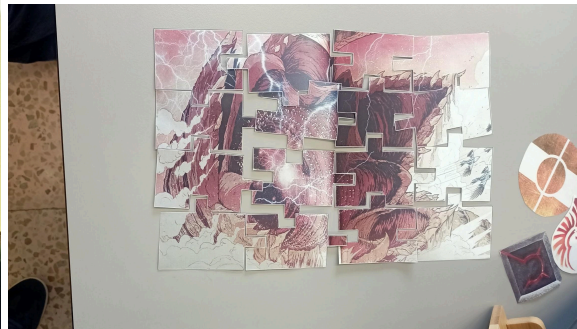


7.5. ANNEX V: CLASSROOM WORK

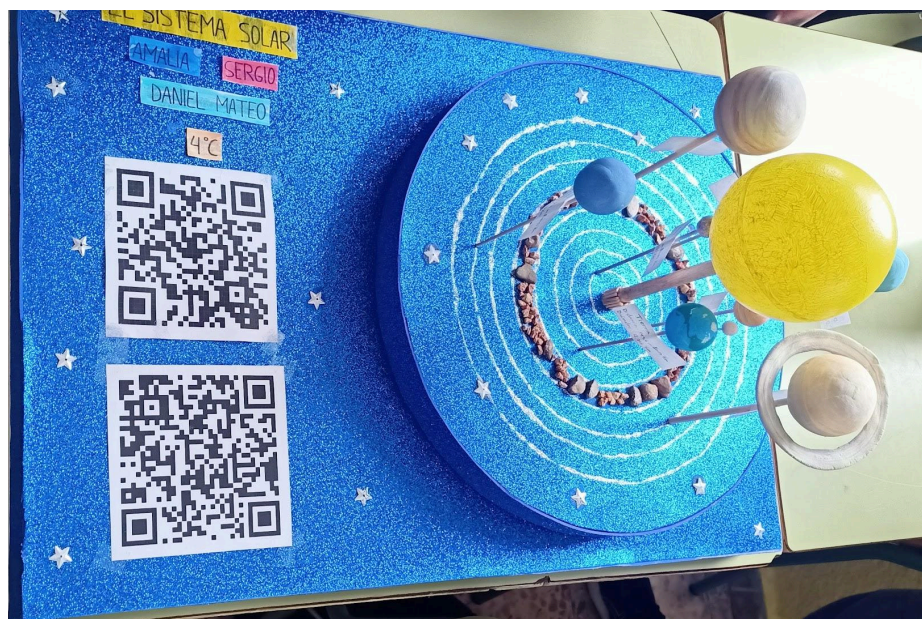
Students' Stories:

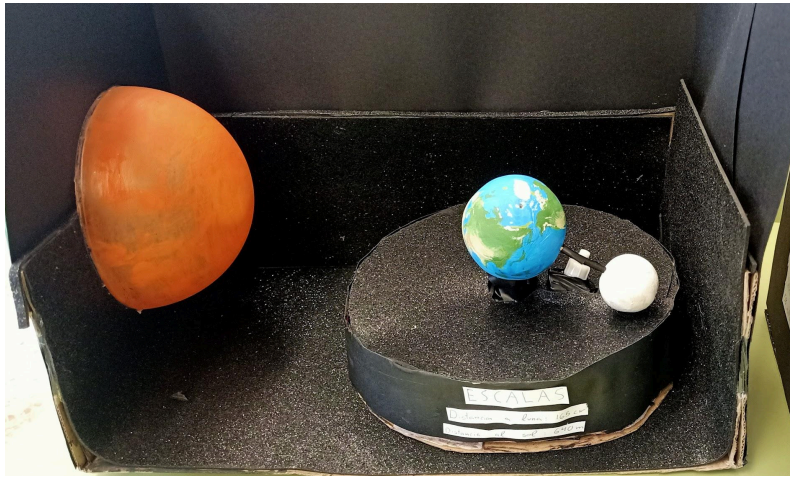
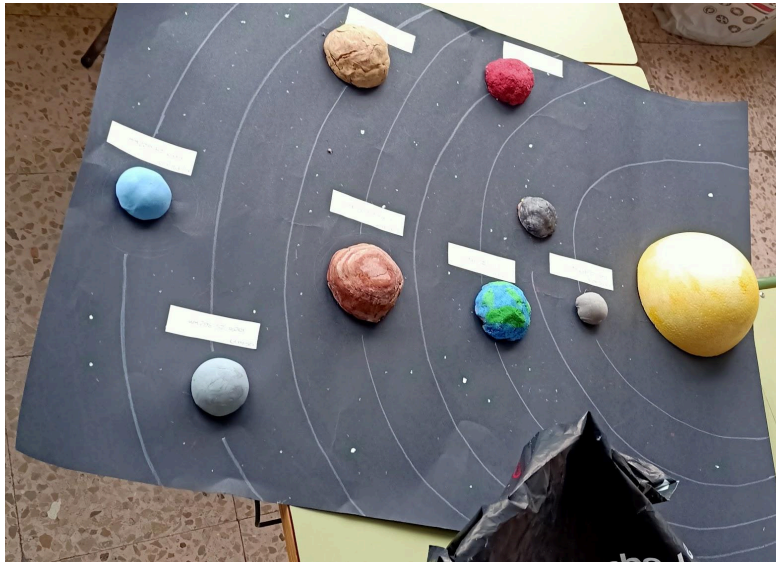


Students doing the Scientific Worksheet



Students' final projects:

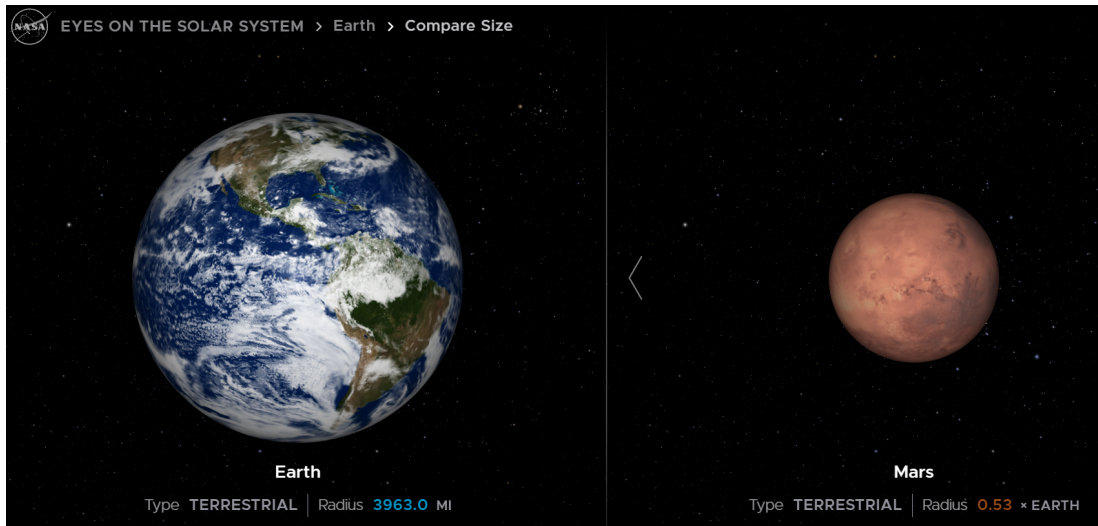




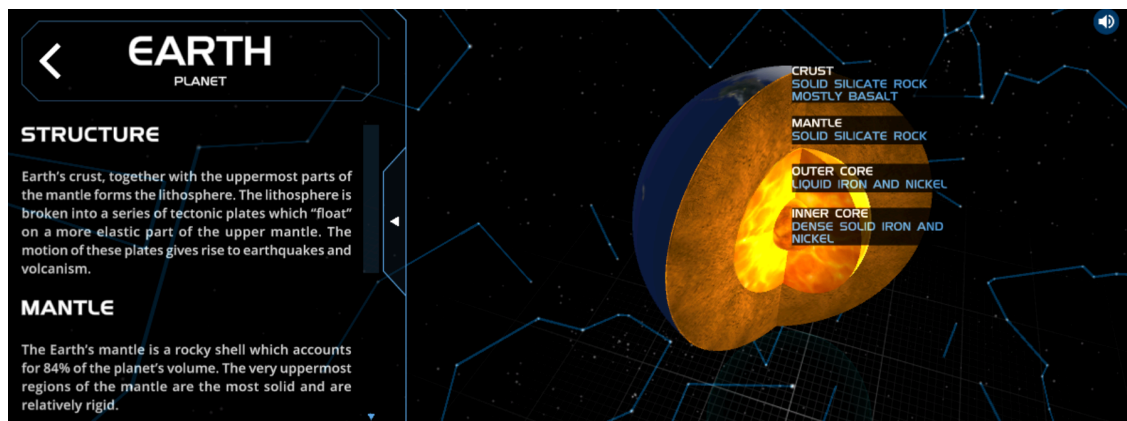
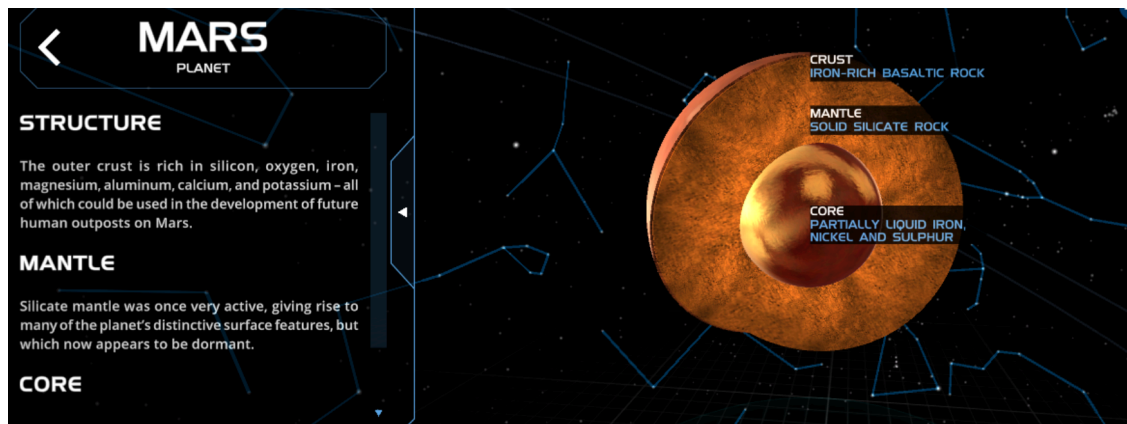


7.6. ANNEX VI: WEBPAGES

NASA



SOLAR SYSTEM SCOPE



7.7. ANNEX VII: ASSESSMENT SLIDES

Session 1:

According to the Big Bang Theory, What appeared First?



☐ Planets
☒ Energy
☐ Galaxy
☐ The Solar System

Trough a nebula, hydrogen atoms and extreme temperature... What is created?



☐ A planet
☐ A black hole
☒ A star
☐ Cosmic dust

A massive star explodes and spreads carbon and oxygen into space. What event is this?



☐ Rotation
☐ Heliosphere
☒ Translation
☐ Supernova

The Milky Way is the galaxy where our Solar System is located.



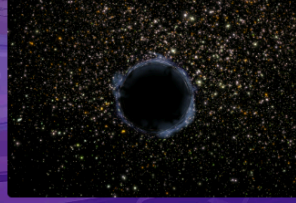
☒ Verdadero
☐ Falso

Stars create heavy elements like carbon and oxygen. Why is this important for life?



☐ Because life needs stars as planets
☐ Because stars control time
☒ Because oxygen creates galaxies
☐ Because life is made from those elements

A black hole is empty space.



☒ Verdadero
☐ Falso

The system consisting of the sun and the celestial bodies that orbit it



☐ Seasons
☐ Gravity
☒ The Solar System
☐ Climate change

Sustainability means using natural resources without damaging future generations.



☒ Verdadero
☐ Falso

Cosmic dust and gravity... What forms?



☒ Planets
☐ Energy waves
☒ Atmosphere
☐ Heat

Which condition is MOST important for habitability?



☐ High density only
☐ No rotation
☒ Very high temperature
☐ Liquid water, energy, bioessential elements, and appropriate conditions

Which option contains ONLY abiotic factors?



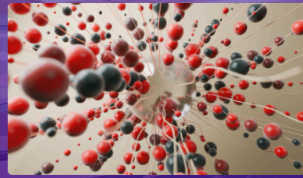
▲ Plants and animals

◆ Bacteria

● Water, temperature and light ✓

■ Forest and insects

Nuclear fusion happens when atoms split into smaller atoms.



◆ Verdadero

▲ Falso ✓

The Supernova is an explosion of a massive star



◆ Verdadero ✓

▲ Falso

What is mostly found in stars?



▲ Hydrogen and Helium ✓

◆ Carbon

● Oxygen

■ Iron

Has a woman ever been to the moon before?



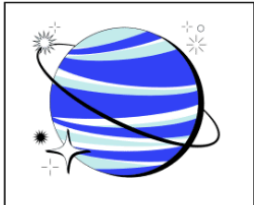
▲ yes

◆ no ✓

FACTS ABOUT URANUS

BASIC INFORMATION

Name:
Basic Information:
Color:
Number of Rings:
Moons:
Diameter:



TEMPERATURE

ATMOSPHERE

ROTATION

OXYGEN COMPOSITION

HABITABILITY

FACTS ABOUT EARTH

BASIC INFORMATION

Name:
Basic Information:
Color:
Number of Rings:
Moons:
Diameter:



TEMPERATURE

ATMOSPHERE

ROTATION

OXYGEN COMPOSITION

HABITABILITY

FACTS ABOUT MARS

BASIC INFORMATION

Name:
Basic Information:
Color:
Number of Rings:
Moons:
Diameter:



TEMPERATURE

ATMOSPHERE

ROTATION

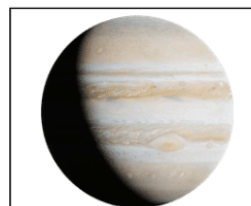
OXYGEN COMPOSITION

HABITABILITY

FACTS ABOUT JUPITER

BASIC INFORMATION

Name:
Basic Information:
Color:
Number of Rings:
Moons:
Diameter:



TEMPERATURE

ATMOSPHERE

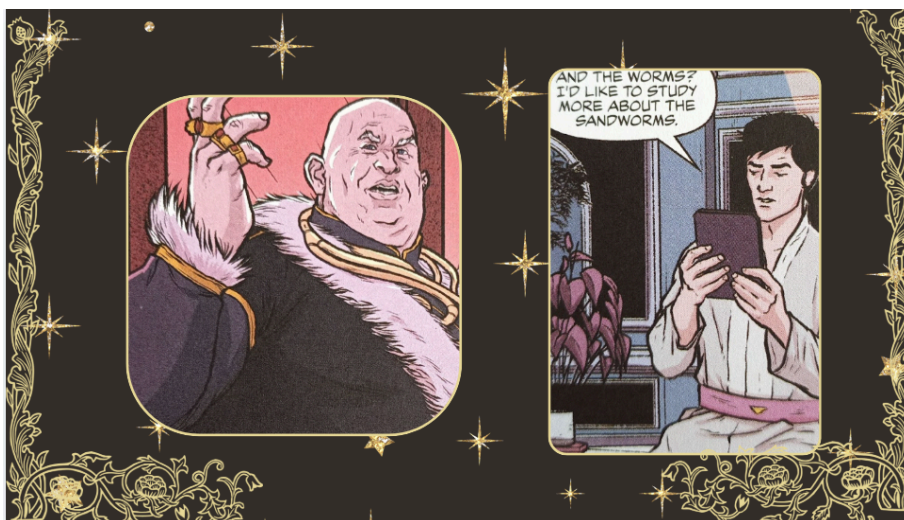
ROTATION

OXYGEN COMPOSITION

HABITABILITY

FACTS ABOUT NEPTUNE	
BASIC INFORMATION	
Name: Basic Information: Color: Number of Rings: Moons: Diameter:	
TEMPERATURE	ATMOSPHERE
ROTATION	OXYGEN COMPOSITION
HABITABILITY	

Session 2:





Session 3:



HOUSE ATREIDES

You are a noble house that believes in fairness and cooperation

 Your goal: Keep peace on Arrakis and protect its people

 Values: fairness, cooperation, and sustainability

Strengths

- People trust you.
- You negotiate well.

Weaknesses

- You avoid conflict.
- Other Houses may manipulate you.

Secret mission: Form at least 1 alliance



HOUSE HARKONNEN

You are a powerful House focused on control. Your House believes survival requires strong control and decisive leadership.

 Your goal: Dominate Arrakis and extract resources (spice production)

 Values: Control, power, dominance and exploitation

Strengths

- fast decisions
- organization
- resource control

Weakness

- people may fear or resist you.

Secret mission: Control most resources



FREMEN

You are Native inhabitants of Arrakis

 Your goal: Survive and protect the desert ecosystem

 Values: survive, adapt, protect, respect nature

Strengths

- survival knowledge
- resilience
- cooperation

Weakness

- limited technology.

Secret mission: Protect water and environment



IMPERIAL SCIENTISTS

You are Scientists studying Arrakis

 Your goal: Understand the planet and manage its resources (spice)

 Values: evidence, data, observe, analyse, innovate, progress

Strengths

- *advanced solutions*
- *creativity*
- *problem solving*

Weakness

- *solutions may ignore emotions or traditions.*

Secret mission: Implement technological solution

Session 4:



EMERGENCY TRANSMISSION

Agents!

Duke Leto ordered the rescue of spice workers before a sandworm attack but field communications were fragmented. House Atreides needs a reconstructed commander's report.

Rewrite the official report using the key intelligence verbs: insisted, warned, explained, ordered, reported, admitted

Field testimonies:

- Leto: "We're not leaving any men for that monster."
- Pilot: "The worm is coming."
- Worker: "The carryall will rescue the crawler, the crew and the load of spice before the worm arrives."
- Technician: "The carryall is late."
- Leto: "Out! Now! This is a command from your Duke!"
- The crew: "We are ready to evacuate."
- The Imperial Scientist: "A leader such as that would command fanatic loyalty. He would be difficult to defeat."

Write the message here





SECURITY IDENTIFICATION SYSTEM



Agents!

After the attack, Atreides Intelligence must identify allies and enemies.

Security records are incomplete

Combine the information to create a security message identifying each person or place clearly.

1. *Paul is the boy. He escaped the attack.*
2. *Jessica is the woman. She protects Paul.*
3. *The palace is the place. The betrayal happened there.*
4. *The soldiers are enemies. They follow the Baron.*
5. *Duncan Idaho is the warrior. He helps them escape.*
6. *The room is dangerous. Leto was captured there.*

Write the message here

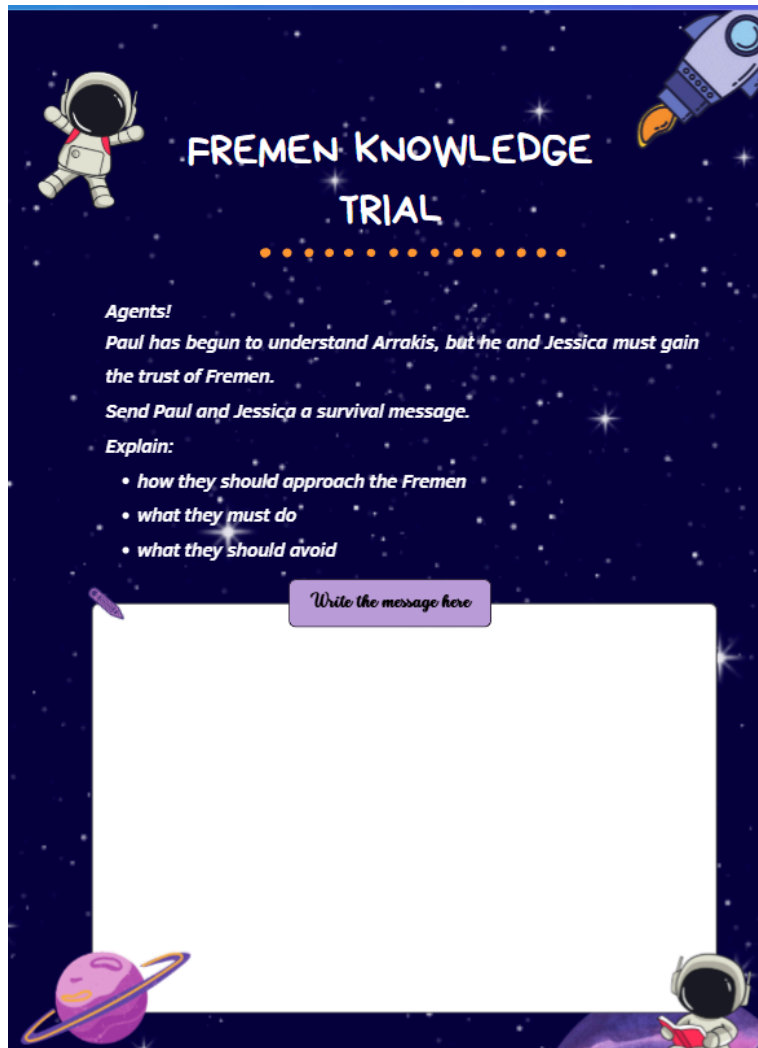




HARKONNEN INTERROGATION

Agents!
The Harkonnen have not discovered yet what happened to Paul and Jessica.
Your task is to predict what enemy interrogators might ask and prepare survival information.
Create an interrogation summary with possible questions the Harkonnen would ask. Then report them as intelligence notes.

Write the message here



Padlet

Surviving

To survive on this planet, you must always wear a special suit to recycle your body's moisture. You need to move quietly and stay in the shadows to avoid the dangerous villains who patrol the desert, so it is always better to travel at night. To obtain resources, use a dustpan with bag to collect the valuable spices from the sand, which will help you stay strong. It is also important to find the local people because they know the locations of secret water tanks and the best places to harvest spices. Finally, you must stay relaxed and enjoy the experience.

Añadir comentario

ERIKA LÓPEZ SANVICENTE A...
hace 15 días

How to survive in Arrakis?

Summary
This news explains that many homes in London are experiencing overheating due to climate change. In the past, houses in the UK were designed to stay warm during the cold winters. However, now the summers are much hotter and these buildings cannot stay cool.

The report says that this is a serious problem because people can't sleep well and it is dangerous for their health, especially for the elderly. Experts suggest that the government should help people to adapt their homes with better insulation, more ventilation, and by planting more trees in the city to reduce the temperature.

Conclusion
In my opinion, this article shows that climate change is affecting our lives in many ways. It is not just about the planet, it is also about our comfort and health inside our own homes. We need to find new solutions and use better technology to build houses that are comfortable in both winter and



Rolls-Royce secures nearly £600m in UK government cash to develop small reactors

The text explains that the UK government has secured £599 million in funding for Rolls-Royce to build small Modular Reactors.

I think this is a really important topic as nuclear energy renders near zero carbon footprint and is key for reducing climate change.

Añadir comentario

Diego Ortega
hace un mes

THE AIR THROUGHOUT OUR HOMES IS INFUSED WITH MICROPLASTICS. BUT THERE ARE THINGS YOU CAN DO TO BREATHE LESS OF THEM



sergiopascual
hace 15 días

SURVIVE

First, you need to wear a high-quality stillsuit to save every drop of water your body loses. It's also very important to walk with an irregular rhythm so the giant sandworms don't hear you coming. You should stay hidden in the shadows during the hot day and only travel when the sun goes down. Try to find the Fremen people and learn from them, because they are the real experts of the desert. Most importantly, keep your mind calm and don't let fear take over, or you won't survive the journey.

Añadir comentario

Nicolas
hace 15 días

To survive in Arrakis, the most important thing is to find

Añadir comentario

Nicolas
hace un mes



'Climate change is kicking our butts.' March smashes heat records for continental US

Summary
The article says that global temperatures are increasing every year. Scientists explain that this is because of pollution and greenhouse gases. It also says that extreme weather like heatwaves and storms are becoming more common. They warn that countries need to act quickly to stop climate change.

Opinion
I think climate change is a very

Añadir comentario

SOFA MEDIÁVILLA RUIZ
hace 15 días

Arrakis

To survive on Arrakis, given that water is a very scarce resource, it is essential to have a device capable of recovering both the planet's moisture and that which our bodies lose. However, beyond technology, our survival depends on our ability to adapt to the environment, treating the desert as both a sacred and dangerous place; we must be aware that it is not our home and that we do not know what we might encounter.

Añadir comentario

lidiarrea

during the night to protect yourself. Be careful with the spice, as it is valuable but can affect your body and mind. Walk carefully to avoid attracting dangerous sandworms.

Añadir comentario

IZARNE CLAUDIA GALDÓS BE...
hace un mes

Climate change increased the intensity of the Valencia storm, according to a study by the Spanish National Research Council (CSIC).



El cambio climático aumentó la intensidad de la dana de Valencia, según un estudio del CSIC

This article was published 17.02.2026, 17.02.2026

• Personal opinion: This study demonstrates that these are not just "natural phenomena," but events amplified by human activity. In my opinion, we need to start anticipating these events instead of just reacting to them instantly. We also must not forget these tragedies quickly, as there are still people who need help.

Añadir comentario

ERIKA LÓPEZ SANVICENTE A...
hace un mes



La conferencia para abandonar los combustibles fósiles que se celebrará en Colombia puede ser una victoria climática inesperada

The news report states that Colombia

the temperature is extremely high. People must wear special suits called stillsuits, which help them save and recycle water from their bodies so they do not get dehydrated. It is also important to move carefully across the desert and avoid walking in a fast rhythm, because giant sandworms can feel the vibrations and come quickly.

People usually travel in groups and look for rocky places where the worms cannot reach them. Water is the most valuable thing on Arrakis, so every drop must be saved and never wasted. To survive, a person must be patient, careful, and respect the dangerous desert environment.

Añadir comentario

Bruno
hace 15 días