

## CORSO DI METODOLOGIA CLIL IPRASE – SSSG INGLESE- 2016/2017

### LESSON PLAN “DNA DUPLICATION”

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**Subject: BIOLOGY**

**CLIL language: ENGLISH**

**Topic: DNA DUPLICATION**

**Time: 100 minutes (2 hours)**

**School: Istituto Tecnico Tecnologico**

**Class: 3<sup>rd</sup> year (curricula Chemistry-Medical Biotechnology)**

**Teacher: Science teacher (English CEFR Level C1)**

**Keywords: DNA, DUPLICATION, ENZYMES, REPLICATION, MOLECULAR BIOLOGY, MESELSON-STAHl EXPERIMENT**

#### Topic of the series of lessons: “DNA: DISCOVERING THE LANGUAGE OF LIFE”

This lesson is part of a module of 10 hours which deals with the famous molecule of DNA. The module has 3 main focuses:

1. The structure of DNA and the famous experiments and scientists that led to its discovery
2. DNA extraction (experimental procedure)
3. The mechanism of DNA duplication and its discovery

The module deals with one of the most important scientific discoveries of the last century and in order to make the students understand how paramount it was, the module adopts a historical approach and also a focus on the comprehension of how Science develops through time.

#### Topic of the lesson: DNA DUPLICATION

The lesson is about the mechanism of DNA duplication and the role of each enzyme involved in the mechanism and it also focuses on how Meselson and Stahl’s experiment demonstrated that DNA duplication was semi-conservative.

#### Analysis of the learning preconditions

**Student group:** in the class in which this module was taught there are 13 students, 4 females and 9 males. Biology is a core-subject of the curriculum of this class (Chemistry and Medical Biotechnology) and so these students are highly motivated to learn it. Their profile as a class is rather good, especially in Chemistry and Biology, while their level of English is much more heterogeneous: most of the students have an English level between A2 and B1 and only a couple of reach a B1+. In this class there are no students with Special Needs and all the students were born in Italy, even if one of them has parents from Tunisia. These students come from different 2<sup>nd</sup> classes and also from different schools, but they all started studying Biology last year. On the contrary, only few of them (2) have had previous CLIL experience at school, so this methodology was completely new for the majority.

In order to successfully complete this CLIL module students should have a basic knowledge of the following:

- **Language prior knowledge:** passive forms, past simple, basic language to describe a process (*First, then, next...*), expressing agreement and disagreement, predicting and justifying hypotheses (about a scientific experiment), giving instructions;
- **Subject prior knowledge:** chemical bonds (covalent and hydrogen bonds), macromolecules and the concept of monomers and polymers, DNA structure, the scientific method, protein and enzyme, cell division.

#### Planning for the module

The module is divided in 5 lessons of 2 hours each (100 minutes). An extra hour of 50 minutes is needed for a final test. In order to let students full-immersed into CLIL, all the classes were given in 3 weeks. The module was planned for the second part of the year (March) so that the students, who came from different second classes, had the time to get to know each other and to reach minimum homogeneous knowledge in Biology and English. In the following grid a brief description of each lesson of the module is presented.

	LESSON AIMS	ACTIVITY PROCEDURE	LANGUAGE SKILLS	INTERACTION	MATERIALS	ASSESSMENT
1	- Being at ease in a CLIL class; Understanding the structure of DNA; -Learn specific vocabulary for the module;	Setting CLIL rules  Refreshing DNA structure while learning specific vocabulary (reading + labelling exercise + matching exercise)  Consolidating knowledge about DNA structure (video+ answering to questions+ comparing answers with peers)  DNA Timeline: teachers introduce DNA structure discovering focusing on how Science develops and changes through time	Content obligatory language  Reading  Listening exercise	Frontal Pair work Plenary	Slide Worksheet 1 Video (subtitles only if needed) Timeline ( <i>Attachment 4</i> )	Students can match the name of DNA parts to their pictures  Students can describe the chemical structure of DNA  Students can agree and disagree about different answers to an exercise

	LESSON AIMS	ACTIVITY PROCEDURE	LANGUAGE SKILLS	INTERACTION	MATERIALS	ASSESSMENT
2	Learn in group about a famous scientist and prepare a written lab report and a presentation	Students are divided into groups: each group reads a text about an experiment/a scientist and writes an experimental report, watching a video on the same topic; The class is in a Computer Science Room so students can surf the internet in order to look for extra information.	Reading  Writing a Experiment Report	Group work (Teacher supports when needed)	Text and video (different for each group) Model of an experimental report .	Students can read a brief text about an experiment and they can write an experimental report following a model; Students can work in group and cooperate.
3	Laboratory: understanding the procedure of DNA Extraction from fruit; Executing the procedure	- Learning vocabulary about lab equipment - Writing the lab procedure through pictures of each single step - Practicing the lab procedure	Writing a lab procedure  Speaking	Frontal Pair work	Slide Lab equipment Setting: Biology LAB	Students can use a technical language to describe simple lab procedure steps; Students can perform a DNA extraction.
4	<b>DNA DUPLICATION LESSON (see the more detailed grid for the planning of the course of the lesson that follows)</b>					
5	Let students recognize that several scientists gave their own contribute to the final discovery of DNA structure; Assess students' ability of giving a presentation on a scientific experiment.	Students give their presentation about one famous experiment or scientist that gave an important contribution to the discovery of DNA structure to the whole class; Students ask questions if they do not understand anything explained by their mates The teacher supports the speakers when giving their speech to the class and the listeners in order to check their comprehension (rephrasing, ask them to rephrase, adding examples...)	Speaking using BICS and CALP  Listening to a speech	Plenary	Some students prepared presentations or videos	Students can present the article they've read and elaborated in group; Students can answer their peers questions about their work  Until the students make themselves understood no language is assessed in order to encourage fluency
6	Assess the knowledge of the students about: DNA structure, DNA duplication and scientific experiments related	Students are given a test with several questions in the form of: -multiple choices -gap filling -true/false	Reading  Writing (not at sentence level)		Paper based test designed by the teacher	Only the content is assessed and not the language because this is the very first CLIL experience of the class

#### Definition of the learning objectives for the lesson

The higher order learning objective for lesson n. 4 about DNA duplication, contained in the CLIL module “DNA: DISCOVERING THE LANGUAGE OF LIFE”, is making the students understand :

- why DNA duplication is paramount for biological processes and for possible biotechnological application
- the difficulties involved in setting a scientific experiment in order to demonstrate how a process works and how it is important to be able to formulate hypotheses and predicting results in order to plan the experiment correctly
- the complexity of biological processes.

The competences in relation to **content** developed through this lessons will comprehend:

Knowledge: define DNA duplication, recall information and specific vocabulary about the DNA structure, be aware of when and why DNA duplication is needed in living organism;

Skills: match the name of enzymes involved in DNA duplication with their specific function; describe the process of DNA duplication in chronological order, distinguishing between the process undergone by the leading strand and the lagging strand; students will be able to identify which enzyme is specific for each chemical reaction that takes place during DNA duplication; they will also be able to describe the procedure of Meselson -Stahl experiment;

Abilities: students will be able to formulate hypotheses about results of Meselson and Stahl's experiment and to interpret possible results with different types of DNA duplication;

The competences in relation to **language** developed through this lessons will comprehend:

Lower order skills: remember vocabulary about DNA structure and DNA duplication (chemical and biological reactions)

Higher order skills: scan and skim a text looking for general and specific information linked to DNA duplication, extrapolate specific information from a video, use proper language to describe a biological process in chronological order

#### Analysis of the lesson in terms of its subject content

In this lesson the DNA duplication will be firstly presented with reference to all the biological processes where it takes place (cell division, growth, cell replacement, reproduction). Secondly, Meselson and Stahl's experiment will be analyzed in order to understand how Science works and how the scientific method had been applied by famous scientists. This scientific experiment demonstrated that the duplication of DNA is semi-conservative, instead of conservative or dispersive. It is a good example to lead student to the formulation of hypotheses and the planning of an experiment.

Finally, the third focus of the lesson is the mechanism of DNA duplication itself: this mechanism is led by several enzymes that cooperate and work consequentially inside cells. While studying these enzymes students will definitely have the opportunity to understand the complexity of biological processes.

#### Analysis of the lesson in terms of its foreign language content

In order to read and understand a scientific text or a video regarding an experiment, students should be able to understand passive forms. Moreover, in order to describe the process of DNA duplication, which is a series of biological reactions, they should understand and be able to use time connectives (*First, then, next,...*). These students have never had Biology in English before but the content obligatory language is very similar to Italian so they will be able to understand most words without explanation (*DNA, enzymes, nucleotides, to digest, to synthesize*). Some new vocabulary will also be learned (*strands, unzip, unwind, replication fork*). In order to make simple hypothesis about experiments students will use future/conditional 1 forms. Students will also encounter a couple of sentences with third type conditional: since this type of language is set inside a context (experiment in the past) they might be able to understand it without knowing how to use it. Especially during pair work, students are invited to check their answers and compare them, discussing if they are different in order to arrive to a common answer: during these phases they need to be able to give opinions, compare and contrast different answers and summarize the discussion when reporting it to the rest of the class.

### Didactic and methodological analysis of the lesson

The topic of DNA duplication is quite central in Biology and even more important in the curriculum of this class that focuses on Biotechnologies. At the end of their studies, not only will these students be able to describe how DNA duplication occurs but they will also have practiced DNA duplication in vitro and they will be aware of the several applications linked to DNA duplication in medicine. In light of this, it is clear that this topic is definitely interesting for the students, and for this reason it was chosen for CLIL.

The whole module has a strong historical approach because, while learning through famous experiments of the past, students do not simply learn but are virtually put in the same conditions of the scientists that discovered these content. Moreover, students are invited to formulate hypotheses on Meselson and Stahl's experiment on the base of what they have learnt in previous classes or just on the base of what they imagine.

In this way, students reinforce their scientific way of thinking and develop awareness that Science is not absolute but it is something that keeps improving. Students also learn to distinguish between what is scientifically demonstrated and what is not and this might be one of the most important competencies useful in their everyday life because nowadays is quite common to give opinion about science without being an expert, especially in social media.

The structure of the lesson is quite traitional: after a short introduction where goals are explained, students are immediately asked to activate their prior knowledge in order to answer to the question "Why is DNA duplication is important?". They will be helped by a picture and guided by the teacher: this is the fourth lesson of the module, so students should have acquired a short list of obligatory language vocabulary that makes them able to answer.

However, students might not know some specific terms and so the teacher will write the new words on the blackboard when required. During activation, students are invited to speak and brainstorm so that they can warm their speaking skills up and be prepared to use English in the subsequent activities. It is important that also the welcome part of the class (students entering the classroom, asking for absent people...) is taught in English for the same reason.

The first focus of the lesson is the Meselson-Stahl experiment: first of all, students have to formulate hypotheses on the mechanism needed to duplicate DNA; the teacher can give them some hints through pictures and through the famous last lines of Watson and Crick paper published in *Nature*, 1953. In this phase, specific CALP words are introduced: students will try to describe the mechanism with some everyday-life language such as "*open*", "*build*" and the teacher can rephrase their sentences by using specific verbs such as "*unwind*", "*unzip*", "*synthesize*". It is important in this phase to write every new word on the blackboard because some students might not remember it just listening to it once or twice. After this introductory phase, the three main hypothetical mechanisms of DNA duplication will be presented through a picture and students will have to vote for the one that they think is the correct one through Mentimeter. In order to use this application, students use their smartphones: this is a moment of "fun" for students who can express their own opinion even if they do not feel completely confident with their speaking skills.

Through these exercise, that precedes the real explanation of the experiment, students can start anticipating what they might see in the video that will follow, use the vocabulary that they have just learnt and, last but not least, they can practice the formulation of hypotheses (a particularly important skill in the scientific disciplines).

The solution of the problem is given through a video. This video is quite long (almost 8 minutes) but it is very clear and the pronunciation of the speaker is standard and easy to understand for Italian students with a B1 level. Students will have to answer to some questions about the video and the teacher should suggest to read the questions in advance in order to know what to look for. The video is watched at least twice, so that students can check if their first answers were correct and moreover, in every certification exam of B1 level (the level of this class), listening records are given twice.

Students will check the answers in pairs, so that they can talk together using sentences to agree and disagree. This revision is made also in a bigger group ( 4 people), so that the same sentence can be repeated again and also students with some difficulties in English can manage to produce these sentences, if they have just heard them. While students compare their answers, the teacher listens and moves from pair to pair in order to correct or help if it is necessary. This can become a formative assessment moment.

The choice of starting with an experiment and not with the mechanism of duplication itself is justified by one general learning objective: students have to learn how Science works and pretending to be the famous scientist that set the experiment by simulating the same conditions helps the development of HOTS such as problem solving skills ("*what would I have done in the same situation*"?).

The second focus of the central part of the lesson is the mechanism of DNA duplication: firstly, it will be generally presented through a text and through a short lecture by the teacher and secondly both a text and a video will be used to present the role of different enzymes in DNA duplication in detail. The choice of using both text and video is due to the fact that different students may have different learning attitudes and, moreover, the reiteration of the same content is quite effective, especially in a CLIL lesson.

In the closing part of the lesson, enzyme flashcards will be used in groups for a matching activity and for playing a game where students have to put enzymes in the order they act on the duplication mechanism: this will allow students to talk together and produce spoken language in a quite informal way, putting them at the centre of the action. The form of the game makes the students confident and the colorful flashcards help them to visualize the DNA duplication process, which is quite complex.

The interactions chosen for the class are gradually more difficult and intense: firstly, students interact with the teacher, then they work in pairs and after that they compare their work in groups and the last 2 activities are completely developed in groups. This will help students gaining confidence about their speaking abilities and in the course of the whole lesson every student will have the opportunity to speak.

## Planning the course of the lesson

phase	Content+ learning objective	What happens in class	Social form	Media	Timing
Introduction	Introduction and explanation of goals	Teacher welcomes the students and describes the goals of the lesson with introductory words	Lecture	<i>Attachment 1_Slides</i>	5'
Activation	Recall prior knowledge about cell division and link the topic to reality. Understand that DNA duplication is basic for cell replacement, growth, reproduction. Warm up phase	Teacher shows a joke about DNA duplication and uses it to ask students what its purpose is. Students answer spontaneously, if they do not know any words they say it in Italian (code switching is allowed) and the teacher writes the word on the blackboard so that students can rephrase their sentences.	Development by questions (interactional)	<i>Attachment 1_Slides</i> Blackboard	10'
Presentation of a problem	Formulate hypotheses about the mechanism of DNA duplication. Underline the importance of Watson & Crick paper as a starting point. Present the three main hypothetical mechanisms (semi-conservative, conservative and dispersive model) Learn content-obligatory language	Teacher shows the last part of Watson & Crick paper (Nature, 1953) highlighting the sentence that refers to a possible DNA duplication mechanism. Students are shown a schematic picture of DNA duplication and are asked to brainstorm about what is necessary for DNA duplication. Students will use content compatible language and teachers will rephrase sentences using more specific words and writing them on the blackboard(example “open” @ “unzip”; “build” @ “synthesize” ...) Three pictures of the three main hypothetical mechanisms of DNA duplication are shown and students have to choose which one fits better to their knowledge.	Lecture + Development by questions (interactional)	<i>Attachment 1_Slides</i> Blackboard Vote through Mentimeter (students use their smartphones)	10'
Solution of the problem	Understand Meselson and Stahl's experiment design and results. Interpret results of an experiment. Practice listening abilities through a video Agree and disagree on different answers	Students watch a video about Meselson and Stahl's experiments. Before doing so, they read the questions they have to answer to. Teachers recall what an isotope is in order to understand the procedure of the experiment. Video is shown twice: during the first view students can ask for interruption if they want to ask meaning of words. Students check their answers with different pairs and then with the teacher in plenary.	Frontal (video) Pair work (answer the question) Group work (compare answers)	Video: <a href="https://www.youtube.com/watch?v=Jeoe gQaF8ig">https://www.youtube.com/watch?v=Jeoe gQaF8ig</a> <i>Attachment 2 Worksheet</i> (Task 1)	25'
Presentation of a problem(2)	Understand the complexity of the biological processes	Teacher introduces the mechanism of DNA duplication dividing it in 3 main steps and recalling what students said in their brainstorming.	Frontal	<i>Attachment 1_Slides</i> Blackboard	5'
Solution of a problem (2)	Scan and skim a text looking for general and specific information; Learn the main steps of DNA duplication and the differences between leading and lagging strand;	Students read a text about DNA duplication mechanism and answer to questions in pairs. Teachers facilitates students moving from one pair to another. At the end, the teacher points out the differences between leading strand and lagging strand.	Pair work Frontal	<i>Attachment 2 Worksheet</i> (Task 2) and text*	10'
Deepening	Learn in detail the functions of the enzymes involved in DNA duplication; Extrapolate specific information from a text and a video in order to be able to match enzyme and function	Students learn about enzymes involved in DNA duplication through a text and a video. They have to complete a table on their worksheet writing the function of each enzyme. While watching the video students take notes. The video is seen twice and between the first and the second view teacher checks the notes of students and asks if something is not clear. After watching the video, each group receives 2 sets of flashcards (one reporting names and pictures of enzymes and the other with descriptions of their functions). Students have to match enzyme and function, discussing together. Teacher checks and corrects or supports.	Group work	Worksheet (task 3) and text* Video (task 4) : “Dna Replication” <a href="https://www.youtube.com/watch?v=TNK WgcFPHqw">https://www.youtube.com/watch?v=TNK WgcFPHqw</a> <i>Attachment 5_Flashcards</i>	15'
Consolidation of outcome	Use proper language to describe a biological process in chronological order;	Students are divided in groups of 4 people. The set of cards with the names of enzymes is put at the centre of the table. Every students draws 2 cards. The goal of the group is to describe the DNA duplication process in chronological order, putting down on the table the correct card at the right moment and explaining what the enzyme does. The game can be played several times, until each student feels confident with the process. Teacher checks and supports.	Group work	<i>Attachment 1_SlideAttachment 2_ Worksheet</i> (Task 5) <i>Attachment 5_Flashcards</i>	15'

\* The Texts are taken and adapted from BIOZONE, Biochemistry and Biotechnology (Zanichelli, 2014)

**Checking the achievement of learning goals and consolidation of outcomes**

During the whole class, the teacher is constantly assessing the achievement for every activity: several times students are guided by teacher's questions that aim to check their comprehension. A constant formative assessment is present throughout the lesson: every time a task is completed, students compare first the results in pairs or in group and then they have a feedback by the teacher in plenary. Moreover, feedback is provided constantly also during group activity.

This class is only made of 13 people so it is quite easy for the teacher to check the comprehension of each student. Nonetheless, peer-evaluation is encouraged. The last activity (the enzyme game) is specifically designed to make the students speak and describe several times the process they need to learn: if students make mistakes they can be corrected by peers or by the teacher.

At the end of the whole module, students will be required to do a test with multiple choices, gap filling and true/false questions (summative assessment on the content). The structure of the test is designed in order to assess content comprehension and not language (for example, no complete sentences have to be written, just few words). The reason of this choice is that students will already be tested on their writing abilities and speaking skills through the group work of lessons n. 5 and n.6 of the module. (See *Attachment 3\_Test*)

**Homework for consolidation purposes**

The last page of the worksheet is a short summary of the mechanism of DNA duplication with two short exercises that will help students to refresh what they learnt in class and review it.