CLIL Module Plan

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School Grade	○ Primary		○ Middle		◉ High
School Year	○ 1	○ 2	○ 3	○ 4	◉ 5
Subject	Fisica	**Topic**	Nuclear physics, subnuclear physics, elementary particles.		
CLIL Language	◉ English		○ Deutsch		

Personal and social-cultural preconditions of all people involved	INSTITUTIONAL FRAMEWORK CONDITIONS The scientific high school "Leonardo da Vinci" is one of the historical “Liceo” of the Province of Trento. Nowadays the high school proposes two curricula, the ordinary scientific curriculum and the applied sciences scientific curriculum. ANTHROPOGENIC AND SOCIO-CULTURAL FACTORS OF THE GROUP OF LEARNERS The class consists of 19 students. There are no SEN students or students of foreign origin. LEARNING PRECONDITIONS The large part of the lessons of the present CLIL module takes place in the classroom. This is equipped with a PC, an interactive whiteboard (IWB), a large blackboard, and a projector. A few activities are carried out in the ICT lab, where each student can use a PC for calculations, data collection, and data analysis. The academic performance of the class for what concerns the scientific subjects is average. The behavior of the students is polite although the level of participation is not high. The majority of the students are motivated and willing to learn new concepts, however there are elements of the class that do not have a specific interest in the subject or perceive the foreign language as a barrier. TEACHER PROFILE The teacher Giovanni Lombardi (“T” in the Module plan), teaches Mathematics and Physics in various classes and grades, and for this CLIL module has the role of main teacher. CEFR level: C1 (IELTS certification dated 18/01/2018). STUDENT GROUP PROFILE All the students are Italian mother tongue, and their average CEFR level is B2, but a few have a C1 certification. The students have already some CLIL experience, as they have followed a total of 60h of CLIL lessons during the previous school years.

Students' prior knowledge, skills, competencies	Subject	Language
	Students have a solid knowledge of classical physics, including electromagnetism. They have a basic knowledge of the main concepts of modern physics, including notions of quantum mechanics (e.g. atomic models,...) and special relativity (e.g. Einstein’s equation E=mc^2,..).	The students have adequate communication skills. They can interact both with the teacher and with their fellow students in English, but they do not have a specific knowledge of the scientific terms necessary to describe the physical phenomena considered in this CLIL module. The students have good reading and writing skills

Timetable fit	◉ Module	Length 10 lessons of 100' each

Description of teaching and learning strategies	• The learning and teaching objectives are disciplinary-specific, interdisciplinary,and communicative. The lessons are designed to encourage the development of problem solving skills, critical thinking, creative thought, collaboration, communication, and time managing. • The methodological approaches are various, in order to meet different learning styles and to promote the development of different skills: interactive lessons, group work (especially when the task is complex), pair work, individual work, TPS (Think, Pair, Share), cooperative learning. During the “student-centered” activities the teacher acts as facilitator and guide. • Interaction and communication are promoted as much as possible by the teachers,(by asking questions and inviting the students to comment or express their ideas) and by activities focused on group or pair work. During these activities, the teacher circulates and models language, concepts and cognition. • A variety of online resources, including videos, diagrams, applets, and practice material is used. • The teacher provides different materials to support content and language scaffolding, and to consolidate learning, e.g. worksheets, extra exercises, and homework. • During most activities a formative assessment by the teachers is provided and peer- or self-evaluation are encouraged. At the end of the Module a summative assessment is provided.

Overall Module Plan

Unit: 1 Nuclear and subnuclear physics **Unit length:** 10 lessons of 100' each	**Lesson 1** Nucleus and binding energy
	Lesson 2 Alpha decay and Beta decay
	Lesson 3 Radioactive decay and radiometric dating
	Lesson 4 Nuclear fission and nuclear fusion
	Lesson 5 Nuclear power plants
	Lesson 6 Quarks and leptons
	Lesson 7 Neutrinos and force carriers
	Lesson 8 CERN and LHC
	Lesson 9 The discovery of the Higgs boson + exercises in preparation to the final test
	Lesson 10 Final test + discussion

CLIL Lesson Plan

Unit number	1	**Lesson number**	1	**Title**	Nucleus and binding energy

Activity	**Timing**	**Learning Outcomes**	**Activity Procedure**	**Language**	**Interaction**	**Materials**	**Assessment**
1	10	Having an overview of the activities that will be carried out during this module.	- T explains the lesson plan for the present module and gives a brief overview of the activities. - Ss can ask questions and clarifications.	**Skills** L S R W **Key vocabulary** Plan, experiment, theory, theoretical, teamwork, pair work, group work, ICT, nuclear physics, elementary particles. **Communicative structures** Sentence structures related to planning, e.g. - We/You are going to…	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	None.	None.

2	15	Employing/activating prior knowledge. Reviewing the knowledge about the components of the nucleus of an atom. Reviewing the concepts of atomic number, of mass number, and of atomic mass unit. Giving opinions/comments.	- T asks Ss to list the main components of the atom and of the nucleus. - The masses and the charges of the various components are listed. - T introduces the term "nucleon" used to indicate a generic component of the nucleon. - T asks Ss to recall the concepts of atomic mass unit, of atomic number, and of mass number. - T shows the periodic table on the IWB. - Ss participate actively to the discussion and take notes.	**Skills** L S R W **Key vocabulary** nucleus, nuclei, proton, neutron, electron, nucleon, isotope, cell, row, column. **Communicative structures** Sentence structures related to physical systems,and to the description of a table, e.g. - the components of the nucleus are... - each cell of the periodic table contains...	☑ Whole class ☐ Group work ☐ Pair work ☐ Individual work	• U1_L1_ALL1.pdf T shows the periodic table (file U1_L1_ALL1,pdf) on the IWB. The picture is available at link in .svg format, and was converted in .pdf format.	Formative: T assesses the insight of the contributions by Ss, as well as the language used.

3	15 [10 video + 5 written]	Understanding the main points of a short introductory video about nuclear physics. Identifying important data, information, and keywords. Vocabulary building.	- Ss watch a video about the basic concepts of nuclear physics. - During the video Ss take notes and ask questions. - At the end of the video Ss have some time to work in pairs on the vocabulary, trying to clarify the meaning of the keywords through discussion and comparison.	**Skills** L S R W **Key vocabulary** proton, neutron, nucleon, isotope, strong nuclear force, binding. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, e.g. - two protons inside the nucleus should repel each other	☒ Whole class ☐ Group work ☒ Pair work ☐ Individual work	shows the video “Nuclear physics: Crash Course Physics #45” - link (from the youtube channel CrashCourse) on the IWB, and stops it at minute 5:21.	None.

4	15	Reviewing the knowledge about special relativity. Learning how to measure the mass of a particle in electronvolts. Combining prior knowledge and new concepts. Taking notes.	- T briefly reviews the main concepts of special relativity studied earlier in the school year. - In particular the famous formula E=mc^2 is considered. - T introduces the electornvolt (eV) and shows how to convert from mass units (e.g. kg, g,..) to eV. - Ss participate to the discussion and review of special relativity, and take notes.	**Skills** L S R W **Key vocabulary** equivalence, special relativity, electronvolt,convert. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, e.g. - The mass of an object can be measured in eV,,, - to convert from kg to eV we...	☑ Whole class ☐ Group work ☐ Pair work ☐ Individual work	None.	Formative: T assesses the contributions of Ss for both content and language.

5	10	Employing the knowledge acquired during the previous activities to solve exercises about the conversion of masses from kg to eV and vice versa. Improving own problem solving skills. Presenting results to peers. Comparing own results with those of peers. Giving opinions/comments.	- T asks Ss to convert the mass of an electron, of a proton and of a neutron in units of eV. - T asks Ss to convert the atomic mass unit from its value in eV (931.5 MeV/c^2) to kg. - The solutions are discussed with the whole class. - A S can be asked to solve the exercises for the whole class at the blackboard.	**Skills** L S R W **Key vocabulary** Electronvolt, atomic mass unit, convert. **Communicative structures** Sentence structures related to receiving instructions, and to discussing results, e.g. - Convert the mass of the proton to electronvolts. - My result is...	☑ Whole class ☐ Group work ☐ Pair work ☑ Individual work	None.	During the activity T goes around the class evaluating the level of participation and omprehension of Ss. Self-assessment: Ss can compare their version of the solution to the correct one.

6	20	Learning the definition of nuclear binding energy. Learning what strong nuclear force is. Identifying relevant quantities and the relations between them. Making hypotheses. Taking notes.	- T introduces the definition of nuclear binding energy. - T explains what are the main properties of the strong nuclear force. - T introduces the concept of nuclar decay. - Ss make hypotheses on how the binding energy could be calculated. - The hypotheses are discussed in plenary. - Ss ask questions and take notes.	**Skills** L S R W **Key vocabulary** Nuclear binding energy, mass defect, nucleon, attractive/repulsive force, decay. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, e.g. - The mass of the nucleus is less than the sum of the masses of its components.	☑ Whole class ☐ Group work ☐ Pair work ☐ Individual work	None.	Formative: T assesses the insight of the hypotheses made by Ss. T informally assesses the language used to formulate the hypotheses.

7	15	Employing the knowledge acquired during the previous activities to solve exercises involving the calculation of the nuclear binding energy for various nuclei. Improving own problem solving skills. Presenting results to peers. Comparing own results with those of peers. Giving opinions/comments. Peer- and self-assessment.	- T asks Ss solve an exercise about the calculation of the nuclear binding energy for three different nuclei. - Ss have 5 minutes to solve the exercise individually. - After 5 minutes Ss form pairs and discuss the solutions with their mate (for about 5 minutes). - The solution is finally discussed with the whole class. - A S can be asked to solve the problem for the whole class at the blackboard.	**Skills** L S R W **Key vocabulary** Nuclear binding energy, mass defect, atomic mass unit, electronvolt. **Communicative structures** Sentence structures related to receiving instructions, and to discussing results, e.g. - Calculate the average binding energy for... - My result is... - Do our results match?	▣ Whole class ☐ Group work ▣ Pair work ▣ Individual work	T shows the text of the exercise (exercise 5 from link) on the IWB.	During the activity T goes around the class assessing the level of participation and comprehension of Ss. Peer- and self-assessment: Ss can compare their solution to their pair mate's one, and to the correct one.

CLIL Lesson Plan

Unit number	1	**Lesson number**	2	**Title**	Alpha decay and Beta decay

Activity	**Timing**	**Learning Outcomes**	**Activity Procedure**	**Language**	**Interaction**	**Materials**	**Assessment**
1	10	Reviewing the concepts learned during the previous lesson. Consolidating the knowledge acquired in the previous lesson.	- T briefly reviews the main concepts examined during the previous lesson. - Ss can ask questions about the contents of the previous lesson. - T sets the goal for this lesson.	**Skills** L S R W **Key vocabulary** Nucleus, nucleon, nuclear binding energy, electronvolt. **Communicative structures** - In the previous lesson we have introduced... - You have learnt that...	☑ Whole class ☐ Group work ☐ Pair work ☐ Individual work	None.	None.

2	15	Learning what an alpha particle is. Learning the main properties of alpha decay. Learning how to write the equation that describes the alpha decay. Identifying relevant quantities and the relations between them. Making hypotheses. Taking notes.	- T explains what an alpha particle is. - T explains the alpha decay process and its main properties. - T encourages the students to use their knowledge of chemistry to write the equation describing the decay process. - Ss make hypotheses on how to write the equation. - The hypotheses are discussed in plenary. - The correct equation for the decay of Uranium-238 is written, highlighting the presence of the energy term ΔE.	**Skills** L S R W **Key vocabulary** Decay, nucleus, helium, mass defect. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, e.g. - An alpha particle is... - The sum of the masses of the decay products is less than the mass of the initial atom.	☑ Whole class ☐ Group work ☐ Pair work ☐ Individual work	None.	Formative: T assesses the insight of the hypotheses made by Ss. T informally assesses the language used to formulate the hypotheses.

3	10	Understanding the main points of a short introductory video about Rutherford's experiment. Identifying important data, information, and keywords. Vocabulary building.	- Ss watch a video about Rutherford's alpha particle scattering experiment. - During the video Ss take notes and ask questions. - At the end of the video Ss have some time to work in pairs on the vocabulary, trying to clarify the meaning of the keywords through discussion and comparison.	**Skills** L S R W **Key vocabulary** Gold, foil, decay, radioactive, alpha particle, dense, concentrated, orbit, shell. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, e.g. - Rutherford used beams of particles as projectiles to... - He used the decay of radioactive elements to produce these beams of particles.	☑ Whole class ☐ Group work ☑ Pair work ☐ Individual work	T shows the video "The Discovery of the Atomic Nucleus (3 of 15)" - link (from the youtube channel Science and Technology Facilities Council) on the IWB.	None.

4	20	Learning the main properties of beta decay. Learning what are the differences between beta+ and beta- decay. Introducing the neutrino. Learning how to write the equation that describes the beta decay. Identifying relevant quantities and the relations between them. Making hypotheses. Taking notes.	- T explains the beta decay process and its main properties. - T introduces the neutrino, explaining its properties. - T encourages the students to use their knowledge of chemistry to write the equations describing the beta+ and beta- decay processes. - Ss make hypotheses on how to write the equations. - The hypotheses are discussed in plenary. - The correct equations for beta+ and beta- processes are derived.	**Skills** L S R W **Key vocabulary** Decay, nucleus, neutron, proton, electron, positron, neutrino, antineutrino. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, e.g. - In beta minus decay, a neutron is converted to a proton. - ...the process creates an electron and an electron antineutrino.	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	None.	Formative: T assesses the insight of the hypotheses made by Ss. T informally assesses the language used to formulate the hypotheses.

5	10	Employing the knowledge acquired during the previous activities to solve two exercises involving beta decay of two different atoms. Improving own problem solving skills. Presenting results to peers. Comparing own results with those of peers. Giving opinions/comments. Peer- and self-assessment.	- T asks Ss write the equations that describe the beta + decay of Carbon-10 and the the beta – decay of Carbon-14. - Ss have 5/7 minutes to solve the problam in pairs. - Ss can consult the periodic table that T shows on the IWB. - The solution is then discussed with the whole class. - A S can be asked to solve the problem for the whole class at the blackboard.	**Skills** L S R W **Key vocabulary** Decay, nucleus, neutron, proton, electron, positron, neutrino, antineutrino. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, e.g. - if a proton changes to a neutron the atomic number will decrease.	☒ Whole class ☐ Group work ☒ Pair work ☐ Individual work	• U1_L1_ALL1.pdf T shows the periodic table U1_L1_ALL1.pdf on the IWB.	During the activity T goes around the class evaluating the level of participation and comprehension of Ss. Peer- and self-assessment: Ss can compare their solution to their pair mate’s one, and to the correct one.

6	20	Reading and understanding a text about the health hazards caused by different kinds of radiation. Identifying relevant concepts and information. Organising information. Cooperating.	- Ss work in groups of 3 / 4. - T hands to each group a printed copy of a text about the health hazards caused by different kinds of radiation. - T briefly introduces the topic. - Ss read the text and discuss its meaning with their group mates. - Ss can use their smartphones to check the meaning of unknown words.	**Skills** L S R W **Key vocabulary** Health hazard, ionization, radiate, radiation, ultraviolet light, damage, screen. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, e.g. - There are lots of physical phenomena classified as radiation - What kinds of radiation can ionize atoms?	☒ Whole class ☒ Group work ☐ Pair work ☐ Individual work	• U1_L2_ALL1.pdf • U1_L2_ALL2.zip T hands out to each group a printed copy of the first part (the part before the cookie test is introduced) of the text “Radiation and the cookie test” (available online at link). See file U1_L2_ALL1.pdf - editable version U1_L2_ALL2.zip.	During the activity T goes around the class evaluating the level of participation and comprehension of Ss, giving advice if needed.

7	15	Employing the knowledge acquired during the previous activity about the health hazards caused by different kinds of radiation. Making hypothesis. Creative thinking. Critical thinking. Cooperating. Giving opinions/comments.	- T presents the cookie test to Ss. - Ss work in groups and think about the solution of the problem at hand. - After 10 minutes the solution is discussed with the whole class. - T assigns exercises about alpha and beta decay processes as homework.	**Skills** L S R W **Key vocabulary** Cookie, radiation, damage, fabric, skin, screen. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, e.g. - alpha particles are particularly bad when they get close to vital tissue, beta...	☒ Whole class ☒ Group work ☐ Pair work ☐ Individual work	• U1_L2_ALL1.pdf The text of the cookie test is found at the end of the document used in the previous activity (U1_L2_ALL1.pdf). The solution can be found online at link .	Formative: T assesses the insight of the hypotheses made by Ss. T informally assesses the language used to formulate the hypotheses.

CLIL Lesson Plan

Unit number	1	**Lesson number**	3	**Title**	Radioactive decay and radiometric dating

Activity	**Timing**	**Learning Outcomes**	**Activity Procedure**	**Language**	**Interaction**	**Materials**	**Assessment**
1	10	Reviewing the concepts learned during the previous lesson. Consolidating the knowledge acquired in the previous lesson.	- T briefly reviews the main concepts examined during the previous lesson. - Ss can ask questions about the contents of the previous lesson and about the solution of the exercises left as homework. - T sets the goal for the lesson.	**Skills** L S R W **Key vocabulary** Nucleus, alpha/beta decay, ionization, health hazard. **Communicative structures** - In the previous lesson we have introduced... - You have learnt that... - Today we are going to study...	☑ Whole class ☐ Group work ☐ Pair work ☐ Individual work	None.	None.

2	20	Learning the universal law of radioactive decay. Identifying the main quantities that describe the decay rate of an element (half-life, decay constant, mean lifetime) and the relations that hold between them. Making hypotheses. Taking notes.	- T derives the law of radioactive decay working out the calculations at the blackboard. - T writes the universal law of radioactive decay in terms of the mean lifetime. - T defines the half-life of an element. - T encourages the students to use their knowledge of mathematics to determine the relation between mean lifetime and half-life. - Ss make hypotheses. - The hypotheses are discussed in plenary. - The correct relation between half-life and mean lifetime is derived.	**Skills** L S R W **Key vocabulary** Decay rate, decay constant, mean lifetime, half-life, exponential, nuclide. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, e.g. - The universal law of radioactive decay describes the statistical behaviour of a large number of nuclides,... - The mean lifetime is the average lifetime of a radioactive particle before decay.	☑ Whole class ☐ Group work ☐ Pair work ☐ Individual work	None.	Formative: T assesses the insight of the hypotheses made by Ss. T informally assesses the language used to formulate the hypotheses.

3	20	Understanding the main points of a short introductory video about radiometric dating Identifying important data, information, and keywords. Vocabulary building.	- Ss watch a video about dating (determining the age of) objects using radioactive elements. - T complements the video with additional information. - During the video Ss take notes and ask questions. - At the end of the video Ss have some time to work in pairs on the vocabulary, trying to clarify the meaning of the keywords through discussion and comparison.	**Skills** L S R W **Key vocabulary** Dating, carbon, carbon dioxide, half-life, radioactive, age, bone, sediment, chamber, sensor. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, e.g. - we want to measure the amount of beta particles that are given off. - 15 beta particles are released every minute,... - the amount of Carbon-14 left is...	☒ Whole class ☐ Group work ☒ Pair work ☐ Individual work	T shows the video “Radiocarbon Dating” - link (from the youtube channel Science and Technology Facilities Council) on the IWB.	None.

4	40	Employing the knowledge acquired in the previous activities to solve problems involving radiometric dating. Using the computer app “Radioactive dating game” to simulate dating processes. Cooperating. Organising the group work. Creative thinking.	- T introduces the goal of the activity and gives basic instructions. - Ss work in groups of 3 / 4 on the PCs available in the ICT lab. - Ss tackle the different activities included in the applet “Radioactive dating game” following the instructions that they find in the document “Computer based activity – Radioactive dating” (file U1_L3_ALL1.pdf), - Ss answer to the questions in the same document.	**Skills** L S R W **Key vocabulary** Dating, tree, probe, decay rate, half-life, custom. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, and to instructions, e.g. - The half-life of Carbon-14 is... - Determine the age of the samples.	☐ Whole class ☒ Group work ☐ Pair work ☐ Individual work	• U1_L3_ALL1.pdf • U1_L3_ALL2.zip Ss work in groups of 3 / 4 on the PCs available in the ICT lab. T hands out to each group a printed copy of the document “Computer based activity – Radioactive dating” (U1_L3_ALL1.pdf – editable version U1_L3_ALL2.zip), The “Radioactive dating game” applet is available at link	During the activity T goes around the class evaluating the level of participation and comprehension of Ss, giving advice if needed. The performance evaluation is done on the answers handed in by the groups.

5	10	Discussing the answers to the questions of the previous activity. Giving opinions/comments.	- The answers to the questions tackled during the previous activity are discussed in plenary. - The concepts examined during the lesson are reviewed and re-elaborated. - Ss can give opinions/comments.	**Skills** L S R W **Key vocabulary** Dating, tree, probe, decay rate, half-life, custom. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, and to describing steps of a process, e.g. - To determine the age of … we had to use Uranium because its half-life is...	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	None.	Formative: T assesses the insight of the answers given by Ss.

CLIL Lesson Plan

Unit number	1	**Lesson number**	4	**Title**	Nuclear fission and nuclear fusion

Activity	**Timing**	**Learning Outcomes**	**Activity Procedure**	**Language**	**Interaction**	**Materials**	**Assessment**
1	10	Reviewing the concepts learned during the previous lesson. Consolidating the knowledge acquired in the previous lesson.	- T briefly reviews the main concepts examined during the previous lesson. - Ss can ask questions about the contents of the previous lesson. - T sets the goal for the lesson.	**Skills** L S R W **Key vocabulary** Radioactivity, decay, radiometric dating, carbon, exponential, mean lifetime, half-life, decay constant. **Communicative structures** - In the previous lesson we have introduced... - You have learnt that... - Today we are going to study...	☑ Whole class ☐ Group work ☐ Pair work ☐ Individual work	None.	None.

2	15	Learning the physics of nuclear fission. Learning how to write the equation that describe a fission process. Making links between different subjects. Making hypotheses. Taking notes.	- T gives a historical overview of the discovery of nuclear fission. - T describes the process of nuclear fission. - T analyses the fission process of U-235. - T encourages the students to use their knowledge of chemistry to determine the equation that describes this process. - Ss make hypotheses. - The hypotheses are discussed in plenary. - The correct equation that describes the fission process of U-235 is derived	**Skills** L S R W **Key vocabulary** Fission, fission product, Uranium, Barium, Kripton, neutron, electronvolt. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, and to describing steps of a process, e.g. - The nucleus of U-236 splits in two lighter nuclei. - In addition to.... three neutron are released.	☒ Whole class ☐ Group work ☐ Pair work ☒ Individual work	None.	Formative: T assesses the insight of the hypotheses made by Ss. T informally assesses the language used to formulate the hypotheses.

3	15	Understanding the main points of a short introductory video about nuclear fission. Identifying important data, information, and keywords. Vocabulary building.	- Ss watch a video about nuclear fission. - T complements the video with additional information. - During the video Ss take notes and ask questions. - At the end of the video Ss have some time to work in pairs on the vocabulary, trying to clarify the meaning of the keywords through discussion and comparison.	**Skills** L S R W **Key vocabulary** Fission, fission product, nucleon, binding energy, drawback, Uranium, Barium, Kripton, neutron, chain reaction, electronvolt, Joule, ton, coal. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, and to describing steps of a process, e.g. - The most stable element is Iron, with... - We are concentrating on very large atoms...	☑ Whole class ☐ Group work ☑ Pair work ☐ Individual work	T shows the video “Nuclear Fission; splitting the atom for beginners: from fizzics.org” - link (from the youtube channel Roger Linsell) on the IWB.	None.

4	30	Employing the knowledge acquired in the previous activities to solve problems involving nuclear fission processes. Using a computer app to simulate fission processes. Cooperating. Organising the group work. Creative thinking.	- T introduces the goal of the activity and gives basic instructions. - Ss work in groups of 3 / 4 on the PCs available in the ICT lab. - Ss tackle the different activities included in the app ”Nuclear fission” following the instructions that they find in the document “Computer based activity – Nuclear fission” (U1_L4_ALL1.pdf), - Ss answer to the questions in the same document. - At the end of the activity each group hands in their answers.	**Skills** L S R W **Key vocabulary** Fission, fission product, nucleon, binding energy, Uranium, Barium, Kripton, neutron, electronvolt, chain reaction, potential well/barrier. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, to instructions, and to describing steps of a process, e.g. - Describe how a neutron can give energy to a nucleus... - A chain reaction is... - The total energy becomes greater than...	☐ Whole class ☒ Group work ☐ Pair work ☐ Individual work	• U1_L4_ALL1.pdf • U1_L4_ALL2.zip Ss work in groups of 3 / 4 on the PCs available in the ICT lab. T hands out to each group a printed copy of the document “Computer based activity – Nuclear fission” (U1_L4_ALL1.pdf – editable version U1_L4_ALL2.zip), The app “Nuclear fission” is available at link	During the activity T goes around the class evaluating the level of participation and comprehension of Ss, giving advice if needed. The performance evaluation is done on the answers handed in by the groups.

5	15	Learning the physics of nuclear fusion. Learning how to write the equation that describe a fusion process. Making links between different subjects. Making hypotheses. Taking notes.	- T describes the importance of the nuclear fusion process mentioning the fusion processes that happen in the core of the Sun. - T describes the process of nuclear fusion. - T analyses the fission process of Deuterium with Tritium. - T encourages the students to use their knowledge of chemistry to determine the equation that describes this process. - Ss make hypotheses. - The hypotheses are discussed in plenary. - The correct equation that describes the fission process of Deuterium with Tritium is derived	**Skills** L S R W **Key vocabulary** Fusion, light element, nucleon, binding energy, Hydrogen, isotope Deuterium, Tritium, Helium, neutron, electronvolt, chain reaction. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, to instructions, and to describing steps of a process, e.g. - The nuclear fusion of Hydrogen isotopes was firs achieved in 1932, - The binding energy per nucleon of elements lighter than Iron is...	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	None.	Formative: T assesses the insight of the hypotheses made by Ss. T informally assesses the language used to formulate the hypotheses.

6	15	Understanding the main points of a short introductory video about nuclear fusion. Identifying important data, information, and keywords. Vocabulary building.	- Ss watch a video about nuclear fusion. - T complements the video with additional information. - During the video Ss take notes and ask questions. - At the end of the video Ss have some time to work in pairs on the vocabulary, trying to clarify the meaning of the keywords through discussion and comparison.	**Skills** L S R W **Key vocabulary** Fusion, nucleon, neutron, proton, binding energy, Hydrogen, Helium, core, star. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, and to describing steps of a process, e.g. - Smaller atoms would be more stable if they combined to form bigger atoms. - the fusion of hydrogen into helium is the main driving power for stars. - in the first stage... in the second stage...	☑ Whole class ☐ Group work ☑ Pair work ☐ Individual work	T shows the video “Nuclear fusion - building new atoms for beginners: from fizzics.org” - link (from the youtube channel Roger Linsell) on the IWB.	None.

CLIL Lesson Plan

Unit number	1	**Lesson number**	5	**Title**	Nuclear power plants

Activity	**Timing**	**Learning Outcomes**	**Activity Procedure**	**Language**	**Interaction**	**Materials**	**Assessment**
1	5	Reviewing the concepts learned during the previous lesson. Consolidating the knowledge acquired in the previous lesson.	- T briefly reviews the main concepts examined during the previous lesson. - Ss can ask questions about the contents of the previous lesson. - T sets the goal for the lesson.	**Skills** L S R W **Key vocabulary** Fission, fusion, nucleon, neutron, proton, binding energy, power plant. **Communicative structures** - In the previous lesson we have introduced... - You have learnt that... - Today we are going to study...	☑ Whole class ☐ Group work ☐ Pair work ☐ Individual work	None.	None.

2	15	Learning how a nuclear power plant works. Activating prior knowledge. Critical thinking. Taking notes.	- T explains how a nuclear (fission) power plant works. - T asks Ss questions to elicit contributions based on the knowledge acquired in the previous lesson. - T shows the schematic diagram of a fission reactor on the IWB.	**Skills** L S R W **Key vocabulary** Reactor, fuel, rod, control rod, moderator, seal, shield, vessel, steam, pump, turbine, generator. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, and to describing steps of a process, e.g. - The containment vessel is made of reinforced concrete. - The boiling water produces steam that...	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	• U1_L5_ALL1.pdf T shows the schematic diagram of a fission reactor (file U1_L5_ALL1.pdf, available online at link in .svg format) on the IWB.	Formative: T assesses the insight of the contributions by Ss as well as the language used.

3	20	Understanding the main points of a short introductory video about nuclear fission power plants. Visualising the elements examined in the previous activity. Identifying important data, information, and keywords. Vocabulary building.	- Ss watch a video about nuclear fission power plants. - The video is a virtual tour of Ontario Power Generation's Darlington Nuclear Generating Station. - T complements the video with additional information. - During the video Ss take notes and ask questions. - At the end of the video Ss have some time to work in pairs on the vocabulary, trying to clarify the meaning of the keywords through discussion and comparison.	**Skills** L S R W **Key vocabulary** Reactor, fuel, rod, seal, weld, bundle, shield, vessel, calandria, turbine, generator. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, and to describing steps of a process, e.g. - The metal tubes are welded together to form... - The fuel bundles are inserted in... - Let’s take a tour of...	☑ Whole class ☐ Group work ☑ Pair work ☐ Individual work	T shows the video “Welcome to Darlington Nuclear Generating Station” - link (from the youtube channel opgvideos) on the IWB.	None.

4	25	Understanding the main points of a short introductory video about the nuclear incident of the Fukushima power plant. Learning about the main nuclear accidents. Identifying important data, information, and keywords. Vocabulary building. Giving opinions/comments.	- T directs a discussion about the safety of nuclear power plants. - T shows a slideshow that lists the main nuclear accidents and (fragments of) a video about the Fukushima accident on the IWB. - Ss participate actively to the discussion giving opinions and discussing their classmate's opinions.	**Skills** L S R W **Key vocabulary** Reactor, fuel, rod, seal, weld, bundle, shield, vessel, ceiling, pool, generator, damage, containment, corium. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, to describing steps of a process, and to giving opinions/comments e.g. - The core is composed of... - The water in the reactor vessel evaporated. - What do you think of...? - Are you in favour.against...?	☑ Whole class ☐ Group work ☐ Pair work ☐ Individual work	T shows the photogallery "The worst nuclear disasters" (from link), and the video "Understanding the accident of Fukushima Daiichi" - link (from the youtube channel Institut de Radioprotection et de Sûreté Nucléaire - IRSN) on the IWB.	T informally assesses the language used by Ss to communicate their hypotheses and comments to the rest of the class.

5	20	Learning the basic concepts of dosimetry. Employing the knowledge about dosimetry to solve a few simple exercises. Improving own problem solving skills. Cooperating. Organising the group work. Taking notes. Self-assessment.	- T briefly introduces the main concepts of dosimetry. - T gives the definitions of the relevant quantities (activity, absorbed dose, equivalent dose), - T gives Ss a link to reach the webpage “Dosimetry and safety” from the website BBC bitesize. - Ss work in groups of 3 / 4 on the PCs available in the ICT lab. - Ss read the text and complete the proposed exercises. - Ss compare their solutions to the correct ones (available on the webpage). The exercises that are not solved in class are left as homework.	**Skills** L S R W **Key vocabulary** Activity, dose, absorbed dose, ionization, becquerel, grey, sievert, roentgen. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, and to receiving instructions e.g. - Activity is measured in ,,, - Calculate the amount of...	☑ Whole class ☑ Group work ☐ Pair work ☐ Individual work	Ss work in groups of 3 / 4 on the PCs available in the ICT lab. T gives them the link to reach the webpage “Dosimetry and safety” from the website BBC bitesize (link: link),	During the activity T goes around the class evaluating the level of participation and comprehension of Ss, giving advice if needed. Self-assessment: Ss compare their solutions to the correct ones.

6	15	Understanding the main points of a short introductory video about ITER: the world’s largest fusion experiment. Identifying important data, information, and keywords. Giving opinions/comments.	- Ss watch a video about ITER: the first prototype of nuclear fusion reactor. - During the video Ss take notes and ask questions. - At the end of the video T and Ss discuss the importance of nuclear fusion plants for the solution of the global energy problem.	**Skills** L S R W **Key vocabulary** Fusion, thermonuclear, Deuterium, pollution, radioactive waste, carbon-based energy. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, and to giving opinions/comments e.g. - The project aims at... - Do you think these power plants could help solving...?	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	T shows the video “ITER: The world's largest fusion experiment | The Edge” - link (from the youtube channel CNBC Life) on the IWB.	T informally assesses the language used by Ss to communicate their opinions to the rest of the class.

CLIL Lesson Plan

Unit number	1	**Lesson number**	6	**Title**	Quarks and leptons

Activity	**Timing**	**Learning Outcomes**	**Activity Procedure**	**Language**	**Interaction**	**Materials**	**Assessment**
1	10	Reviewing the concepts learned during the previous lesson. Consolidating the knowledge acquired in the previous lesson. Self-assessment.	- T briefly reviews the main concepts examined during the previous lesson. - Ss can ask questions about the contents of the previous lesson and about the solution of the exercises left as homework. - T sets the goal for the lesson.	**Skills** L S R W **Key vocabulary** Nucleus, alpha/beta decay, fission, fusion, energy, power plant. **Communicative structures** - In the previous lesson we have introduced... - You have learnt that... - Today we are going to study...	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	None.	Self-assessment: Ss can compare their solutions to the correct ones.

2	15	Learning what quarks are. Learning the properties of the six types (or flavours) of quarks. Employing the knowledge about the properties of protons and neutrons to understand which quarks constitute them. Identifying important data, information, and keywords. Making hypotheses. Taking notes. Self-assessment.	- T explains what quarks are. - T explains the properties of the 6 types of quarks. - after introducing Up and Down quarks, T asks Ss to guess how a proton and a neutron are composed. - Ss make hypotheses. - T shows the video “What are Quarks? | Physics | The Fuse School” on the IWB. - The video includes the answer to the question about the quark composition of neutrons and protons.	**Skills** L S R W **Key vocabulary** Quark, antiquark, flavour, up, down, strange, charm, top, bottom, spin, colour, gluon, counterpart. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, e.g. - There are six types (or flavours) of quarks:… - A proton is composed of two Up quarks, and one Down quark.	☒ Whole class ☐ Group work ☐ Pair work ☒ Individual work	T shows the video “What are Quarks? | Physics | The Fuse School” - link (from the youtube channel FuseSchool - Global Education) on the IWB.	Formative: T assesses the insight of the hypotheses made by Ss. T informally assesses the language used to formulate the hypotheses. Self-assessment: Ss can compare their hypotheses to the correct answer given in the video.

3	15	Learning the definition of hadron. Learning one way to classify hadrons based on their quark composition. Identifying important data, information, and keywords. Taking notes.	- T defines what a hadron is. - T introduces the classification of hadrons (based on their quark composition) into mesons and baryons. - T shows the video “A Level Physics - Baryons and Mesons in terms of their Quarks” on the IWB. - Ss take notes and ask questions.	**Skills** L S R W **Key vocabulary** Quark, antiquark, flavour, up, down, strange, charm, top, bottom, spin, colour, hadron, baryon, meson, baryon number. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, e.g. - A hadron is a particle composed of quarks and/or antiquarks. - Baryons are particles composed of... -	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	T shows the video “A Level Physics - Baryons and Mesons in terms of their Quarks” - link (from the youtube channel Physics Online) on the IWB.	None.

4	15	Employing the knowledge about quarks and hadrons acquired during the previous activities. Making hypotheses. Cooperating.	- T briefly explains the conditions that must be fulfilled when combining quarks to forma a hadron. These conditions are summarised in the document “Building a hadron”. - Ss work in groups of 3 / 4 and try to find 5 combinations of three quarks (or of a quark and an antiquark) that could form a hadron.	**Skills** L S R W **Key vocabulary** Quark, antiquark, flavour, up, down, strange, charm, top, bottom, spin, colour, hadron, baryon, meson, baryon number. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, and to instructions, e.g. - A the baryon number of a hadron must be either 0 or 1. - Now build your own hadrons!	☐ Whole class ☒ Group work ☐ Pair work ☐ Individual work	• U1_L6_ALL1.pdf • U1_L6_ALL2.zip T hands out to each group of 3 / 4 Ss a printed copy of the document “Building a hadron” (U1_L6_ALL1.pdf – editable version U1_L6_ALL2.zip).	During the activity T goes around the class evaluating the level of participation and comprehension of Ss, giving advice if needed.

5	15	Seeking information online. Checking own hypotheses. Cooperating. Self-assessment.	- Ss work in groups of 3 / 4 on the PCs available in the ICT lab. - Ss seek information online to confirm the validity of the hypotheses they made in the previous activity. - After 10 minutes T gives Ss the link to the online applet “Subatomic particles’ zoo” where Ss can find information about the particles that they have hypothesised (if they exist).	**Skills** L S R W **Key vocabulary** Quark, antiquark, flavour, up, down, strange, charm, top, bottom, spin, hadron, baryon, meson, baryon number, pion, kaon, lambda, sigma. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, and to instructions, e.g. - Seek information online to confirm that the hadrons you predicted really exist! - Our first particle exists and is called pion!	☐ Whole class ☒ Group work ☐ Pair work ☐ Individual work	After 10 minutes T gives Ss the link to the online applet “Subatomic particles’ zoo” - link	Self-assessment: Ss can check the validity of the hypotheses made in the previous activity and evaluate their own level of comprehension.

6	15	Learning what leptons are. Learning the main properties of the three types of leptons and of their corresponding neutrinos. Seeking information online. Identifying important data, information, and keywords. Taking notes.	- T asks Ss to browse the lepton section of the “Subatomic particles’ zoo” applet used in the previous section. - T explains what leptons are. - T explains the properties of electron, muon, and tau, and of their corresponding neutrinos. - Ss take notes and ask questions.	**Skills** L S R W **Key vocabulary** Lepton, electron, positron, muon, tau, neutrino. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, and to instructions, e.g. - Browse the lepton section of the subatomic particle zoo. - What is the mass of the muon? - There are 6 types of leptons:…	☒ Whole class ☒ Group work ☐ Pair work ☐ Individual work	For the first part of the activity Ss use the online applet “Subatomic particles’ zoo” - link	None.

7	15	Employing the knowledge acquired during the previous activities. Improving own problem solving skills. Presenting results to peers. Comparing own results with those of peers. Giving opinions/comments.	- T asks Ss to complete the two exercises 1 and 2 of the document “Exercises on elementary particles”. - Ss have 5 minutes to solve the problem individually. - Then Ss form pairs and discuss the solutions with their mate (for about 5 minutes). - The solution is finally discussed with the whole class. - A S can be asked to solve the problem for the whole class at the blackboard. - The exercises of the document “Exercises on elementary particles” that were not completed in class are left as homework.	**Skills** L S R W **Key vocabulary** Lepton, electron, positron, muon, tau, neutrino. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, and to instructions, e.g. - Solve exercises 1 and 2 of... - Keep in mind the rules for building a “hadron”. - Explain to your colleagues how you solved the problem.	▣ Whole class ☐ Group work ▣ Pair work ▣ Individual work	• U1_L6_ALL3.pdf • U1_L6_ALL4.zip T hands out to each S a printed copy of the document “Exercises on elementary particles” (file U1_L6_ALL3.pdf – editable version U1_L6_ALL4.zip)	During the activity T goes around the class evaluating the level of participation and comprehension of Ss (asking targeted questions if necessary). Peer- and self-assessment: Ss can compare their solutions to those of their pair-mate and to the correct ones.

CLIL Lesson Plan

Unit number	1	**Lesson number**	7	**Title**	Neutrinos and force carriers

Activity	**Timing**	**Learning Outcomes**	**Activity Procedure**	**Language**	**Interaction**	**Materials**	**Assessment**
1	10	Reviewing the concepts learned during the previous lesson. Consolidating the knowledge acquired in the previous lesson. Self assessment.	- T briefly reviews the main concepts examined during the previous lesson. - Ss can ask questions about the contents of the previous lesson and about the solution of the exercises left as homework. - T sets the goal for the lesson.	**Skills** L S R W **Key vocabulary** Quark, up, down, strange, charm, top, bottom, hadron, baryon, meson, lepton, electron, muon, tau, spin. **Communicative structures** - In the previous lesson we have introduced... - You have learnt that... - Today we are going to study...	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	• U1_L6_ALL3.pdf	Self assessment: Ss compare their solutions to the correct ones.

2	15	Learning how neutrinos were discovered. Learning how neutrinos interact with matter (i.e. why neutrinos are hard to detect). Identifying important data, information, and keywords. Taking notes.	- T explains how neutrinos were discovered - T explains how neutrinos interact with matter and why they are hard to detect. - Ss take notes and ask questions.	**Skills** L S R W **Key vocabulary** Neutrino, electron, muon, tau, beta decay, weak force. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, and to instructions, e.g. - The existence of neutrinos was hypothesised when... - The first experimental evidence was found in...	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	None.	None.

3	20	Understanding the main points of two short introductory videos about IceCube and Super Kamiokande: two of the most important neutrino experiment in the world. Identifying important data, information, and keywords. Giving opinions/comments.	- Ss watch two videos: one about IceCube, and one about Super Kamiokande. - T complements the videos with an oral explanation. - During the videos and the explanation Ss take notes and ask questions.	**Skills** L S R W **Key vocabulary** Ice, cube, clear, solid, photomultiplier, scintillator, Cherenkov medium, sonic boom, shield, ton, cylinder. **Communicative structures** Sentence structures related to the description of physical systems/phenomena,, e.g. - The IceCube detector is situated in... - Super Kamiokande is a detector...	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	T shows the video “Why neutrinos matter - Sílvia Bravo Gallart” - link (from the youtube channel TED-Ed) and the video “Stalking the Wild Neutrino | Cosmos: A Spacetime Odyssey” - link (from the youtube channel Natural Geographics) on the IWB.	None.

4	15	Learning how particles can be classified into bosons and fermions. Reviewing the concept of spin (of a particle). Learning that the fundamental forces are “carried” by bosonic particles. Identifying important data, information, and keywords. Taking notes.	- T explains how particles can be classified into bosons and fermions based on their spin. - T mentions Pauli’s exclusion principle. - T introduces the force carriers for the electromagnetic force, the weak nuclear force, and the strong nuclear force. - T mentions that a force carrier boson for the gravitational force (the graviton) has not been discovered yet. - Ss take notes and ask questions.	**Skills** L S R W **Key vocabulary** Fermion, boson, spin, exclusion, integer, half-integer, force carrier, quantum/quanta, field. **Communicative structures** Sentence structures related to the description of physical systems/phenomena,, e.g. - A boson is a particle with integer spin. - The force carrier for the electromagnetic force is the photon.	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	None.	None.

5	40	Learning about the fundamental forces and the interactions they govern. Employing the knowledge acquired during the previous activities and the previous lesson. Making links between different subjects. Cooperating. Organising the group work. Taking notes. Self-assessment.	- A complete description of the activity, as well as the necessary material, is available at link - T explains the rules and the goals of the activity. - Ss work in groups of 3 / 4 on the assigned task. - The results are discussed in plenary at the end of the activity.	**Skills** L S R W **Key vocabulary** Fundamental force, force carrier, boson, relative strength, bind. **Communicative structures** Sentence structures related to the description of physical systems/phenomena,, e.g. - Now let’s examine the relative strengths of the four fundamental forces.	☒ Whole class ☒ Group work ☐ Pair work ☐ Individual work	The material for the activity is available at link	During the group activity T goes around the class evaluating the level of participation and comprehension of Ss, giving advice if needed. Self-assessment: Ss can evaluate their level of comprehension based on the final discussion.

CLIL Lesson Plan

Unit number	1	**Lesson number**	8	**Title**	CERN and LHC

Activity	**Timing**	**Learning Outcomes**	**Activity Procedure**	**Language**	**Interaction**	**Materials**	**Assessment**
1	5	Reviewing the concepts learned during the previous lesson. Consolidating the knowledge acquired in the previous lesson.	- T briefly reviews the main concepts examined during the previous lesson. - Ss can ask questions about the contents of the previous lesson. - T sets the goal for the lesson.	**Skills** L S R W **Key vocabulary** Quark, up, down, strange, charm, top, bottom, hadron, baryon, meson, lepton, electron, muon, tau, spin, boson, fermion, force carrier. **Communicative structures** - In the previous lesson we have introduced... - You have learnt that... - Today we are going to study...	☑ Whole class ☐ Group work ☐ Pair work ☐ Individual work	None.	None.

2	20	Reviewing the knowledge acquired in the previous lessons. Learning about the Standard Model of elementary particles. Identifying important data, information, and keywords. Taking notes.	- T explains which particles are part of the Standard model of elementary particles. - T mentions the Higgs boson. - The explanation is complemented by the video “The standard model”. - Ss take notes and ask questions.	**Skills** L S R W **Key vocabulary** Quark, up, down, strange, charm, top, bottom, lepton, electron, muon, tau, spin, boson, fermion, gluon, force carrier. **Communicative structures** Sentence structures related to the description of physical systems/phenomena,, e.g. - The standard model of elementary particles is the theory that... - The last piece of the puzzle is...	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	T shows the video “The standard model” - link (from the youtube channel Fermilab) on the IWB.	None.

3	25	Learning about history of CERN. Learning about the main scientific discoveries made at CERN. Identifying important data, information, and keywords. Taking notes.	- T gives an overview of the history of CERN, from the foundation to the discovery of the Higgs boson, - The explanation is complemented by the video “CERN: 50 years of science”. - Ss take notes and ask questions.	**Skills** L S R W **Key vocabulary** CERN, science, scientist, discovery, cyclotron, synchrotron, collider, collaboration. **Communicative structures** Sentence structures related to the description of physical systems/phenomena and past events, and to instructions, e.g. - Take notes. - In the next activity you are going to use your notes to... - In...announced the discovery of... - CERN is building the largest, more powerful collider...	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	T shows the video “CERN: 50 years of science” - link (from the youtube channel CERN). Detailed information about the history of CERN is available at link	None.

4	30	Creating a timeline describing the history of CERN. Having an overview of the scientific discoveries made at CERN. Cooperating. Organising the group work. Peer-assessment.	- T directs a brainstorming session in which Ss discuss which events should be included in the timeline. - After 5/10 minutes T forms groups of 3 / 4 Ss and assigns to each group a few events to describe. - Ss work in groups to write a short description for each event that was assigned their group. - After 15 more minutes each group passes their work on to the next group that corrects it. - The timeline is then composed by combining the contributions from all the groups.	**Skills** L S R W **Key vocabulary** Timeline, event, milestone, discovery, project. **Communicative structures** Sentence structures related to the description of physical systems/phenomena and past events, and to instructions, e.g. - Select the events that you want to appear in the timeline. - Write a short description of the event. - In … CERN scientists discovered...	☒ Whole class ☒ Group work ☐ Pair work ☐ Individual work	Each group receives a (coloured) paper. At the end of the activity the papers are combined in the form of a poster.	Peer-assessment: each group corrects the work of another group Ss can analyse the corrections made by another group to their work.

5	20	Learning how particle acceslerators work. Learning about different kinds of particle accelerators. Activating prior knowledge about the motion of a charged particle in an electric field and in a magnetic field. Identifying important data, information, and keywords. Taking notes.	- T explains how particle accelerators work. - T asks Ss how a charged particle moves in a constant electric field. - Based on the answer T introduces linear accelerators. - T asks Ss how a charged particle moves in a magnetic field. - T introduces cyclotrons and synchrotrons. - The explanation is complemented by two videos. - Ss take notes and ask questions.	**Skills** L S R W **Key vocabulary** Linear acceleration, cyclotron, synchrotron, uniform electric field, supply, magnetic field, beam, bend. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, e.g. - How does a charged particle move in a uniform electric field? - The beam is bent thanks to...	☑ Whole class ☐ Group work ☐ Pair work ☑ Individual work	T runs the videos “How does an atom-smashing particle accelerator work? - Don Lincoln” - link (from the youtube channel TED-Ex), and “LHC animation: The path of the protons” - link (from the youtube channel CERN) on the IWB.	Formative: T assesses the content of the answers given by Ss. T informally assesses the language used to formulate the answers.

CLIL Lesson Plan

Unit number	1	**Lesson number**	9	**Title**	The discovery of the Higgs boson + exercises in preparation to the final test

Activity	**Timing**	**Learning Outcomes**	**Activity Procedure**	**Language**	**Interaction**	**Materials**	**Assessment**
1	10	Reviewing the concepts learned during the previous lesson. Consolidating the knowledge acquired in the previous lesson.	- T briefly reviews the main concepts examined during the previous lesson. - Ss can ask questions about the contents of the previous lesson. - T sets the goal for the lesson.	**Skills** L S R W **Key vocabulary** Particle accelerator, electric field, magnetic field, boson, Higgs, mass. **Communicative structures** - In the previous lesson we have introduced... - You have learnt that... - Today we are going to study...	☑ Whole class ☐ Group work ☐ Pair work ☐ Individual work	None.	None.

2	20	Learning about particle detectors. Learning about the four main experiments currently running at LHC: (CMS, ATLAS, Alice, and LHCb). Identifying important data, information, and keywords. Taking notes.	- T briefly explains how various kinds of particle detectors work. - T briefly describes the four main experiments currently running at LHC. - T shows Ss the presentation “Collider experiments” (file U1_L9_ALL1.odp). -The explanation is complemented by the video “An introduction to the CMS Experiment at CERN”. - Ss take notes and ask questions.	**Skills** L S R W **Key vocabulary** Detector, calorimeter, photomultiplier, sensor, vertex, silicon, layer, magnet. **Communicative structures** Sentence structures related to the description of physical systems/phenomena,, e.g. - The four main experiments at LHC are... - The goals of CMS are:... -The main questions are...	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	• U1_L9_ALL1.odp T shows the presentation “Collider experiments” (file U1_L9_ALL1.odf) on the IWB. T shows the video “An introduction to the CMS Experiment at CERN” - link (from the youtube channel CERN) on the IWB.	None.

3	10	Learning about the Higgs boson and its discovery. Identifying important data, information, and keywords. Taking notes.	- T briefly explains what the Higgs boson is. - The explanation is complemented by the video “What is the Higgs boson?” in which prof. David Ellis gives a simple and intuitive explanation of the Higgs interaction mechanism. - T reviews the history of the discovery of the Higgs boson. - Ss take notes and ask questions.	**Skills** L S R W **Key vocabulary** Higgs, field, boson, interaction, mass. **Communicative structures** Sentence structures related to the description of physical systems/phenomena,, e.g. - Different particles interacted in different ways with the Higgs field.	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	T shows the video “What is the Higgs boson?” - link (from the youtube channel CERN) on the IWB.	None.

4	25	Learning about some of the basic concepts of data analysis and parameter fitting. Activating prior knowledge about statistics. Making links between different subjects.	- Ss play the introductory part of the “Virtual Atom Smasher” game: ”Virtual Atom Smasher is a revolutionary educational game that brings you along with	**Skills** L S R W **Key vocabulary** Theory, parameters, fit, reproduce, tune, estimate.	☐ Whole class ☒ Group work ☐ Pair work ☐ Individual work	The online game “Virtual Atom Smasher” is available at link	During the group activity T goes around the class evaluating the level of participation and comprehension of Ss, giving

		Cooperating. Creative and critical thinking. Self-assessment.	the theoretical physicists inside CERN! Playing this game you are not only learning about particle physics, but you are actively helping scientists with their research!” - Ss play the game in groups of 3 / 4 using the PCs available in the ICT lab. - Ss need to register to play the game: during the registration they have to complete a simple test with questions about the topics considered in this module. - Ss can play on at home using their personal devices.	**Communicative structures** Sentence structures related to the description of physical systems/phenomena,, e.g. - Some parameters of the theory are free and can be tuned. - Change the values of the parameters to...			advice if needed. Self-assessment: the test included in the registration procedure gives immediate feedback, hence Ss can evaluate their level of comprehension.
5	35	Exploiting the knowledge acquired during the previous lessons to complete exercises that cover the main topics	- T asks Ss to work individually on the solution of the exercises from the exercise sheet “Exercises	**Skills** L S R W	☒ Whole class ☐ Group work ☒ Pair work	• U1_L9_ALL2.pdf • U1_L9_ALL3.zip T hands out to each pair of Ss a printed	During the activity T goes around the class assessing the level of comprehension

		the main topics encountered during the present CLIL module. Writing equations that describe decay reactions. Combining knowledge and methods from different subjects. Time management. Giving comments/opinions.	sheet "Exercises in preparation to the unit test" (file U1_L9_ALL2.pdf). - After 15 minutes Ss form pairs and compare their solutions. - After 10 more minutes the solutions are discussed in plenary. - Ss can be asked to solve the exercises for the whole class at the blackboard.	**Key vocabulary** all the scientific terms used in the rest of the module. **Communicative structures** Sentence structures related to the description of physical systems/phenomena, to instructions, and to giving opinions/comments, e.g. - Calculate the value of... - My result is... - What is your result? - Do your results match?	▣ Individual work	copy of the exercise sheet "Exercises in preparation to the unit test" (file U1_L9_ALL2.pdf – editable version: U1_L9_ALL3.zip).	comprenension and participation of the Ss. Self-assessment: Ss compare their solutions to their pair-mate's one and to the correct one.

CLIL Lesson Plan

Unit number	1	**Lesson number**	10	**Title**	Final test + discussion

Activity	**Timing**	**Learning Outcomes**	**Activity Procedure**	**Language**	**Interaction**	**Materials**	**Assessment**
1	60	Understanding the text and the requests of the test. Employing the knowledge acquired during this module to solve exercises of various difficulty levels. Completing an info-graphic. Creative thinking. Problem solving skills.	- Ss employ the knowledge acquired during this unit to solve five exercises of various difficulty levels. - T hands out the test and reads the questions out loud, making sure that all Ss have understood the tasks.	**Skills** L S R W **Key vocabulary** Scientific terms used in the rest of the module. **Communicative structures** Sentence structures necessary to answer a question, and to receiving instructions, e.g. - complete the figure below. - calculate the value of...	☐ Whole class ☐ Group work ☐ Pair work ☑ Individual work	• U1_L10_ALL1.pdf • U1_L10_ALL2.zip Each student receives a printed copy of the file "Physics test" (file U1_L10_ALL1.pdf - editable version U1_L10_ALL2.zip).	Performance evaluation.

2	30	Understanding the mistakes done in the test. Evaluating own work. Reflecting on different solution strategies.	- T works out the correction of the various exercises at the blackboard. - Ss ask questions and propose alternative solutions. - The solution of the exercises are discussed.	**Skills** L S R W **Key vocabulary** Scientific terms used in the rest of the module. **Communicative structures** Sentence structures related to mathematical relations, to the descriptions of (steps of) a process, and to proposing alternatives, e.g. - I have solved that exercise in a different way:...	▣ Whole class ☐ Group work ☐ Pair work ☐ Individual work	• U1_L10_ALL1.pdf T shows the document "Physics test" (file U1_L10_ALL1.pdf) on the IWB.	Self-assessment: Ss compare their solutions to the correct ones.

3	10	Having an overview of the topics examined during the CLIL module. Giving opinions and comments.	- T briefly reviews the topics covered during the module. - Ss give opinions and comments about the topics (e.g. interesting/not	**Skills** L S R W **Key vocabulary** Scientific terms used in the rest of the module. **Communicative structures** Sentence structures related to giving opinions/comments, e.g. - I think that the topic of this module is... - I believe that thte lesson about ... was...	☒ Whole class ☐ Group work ☐ Pair work ☐ Individual work	None.	None.