TitleTitle

Hunting neutrinos

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Role: Teacher

Short description/ main ideaShort description/ main idea

Students must be engaged in a highly motivating learning experience, which is closely related to the tasks and challenges of the real world.Therefore, emphasis must be given on the learning-by-doing, where the activities in authentic context are strongly emphasized, which means the skills needed in working life, such as being able to work in teams, working in self-guided manner, and assessing of own actions (Thomas, 2000).

Learning activitiesLearning activities

Phase 1: Definition of the Project Goal
Description of phase: A new era in Astronomy and Cosmology raises. Neutrinos are gathering information from the cores of the stars, while travelling through the universe from the very beginning of the cosmos. Reaching Earth a shower of particles spreads all over the planet and scientists are hunting the “unsocial” neutrinos. Catching just one neutrino, important knowledge can be gained from the depths of stars and the initiatives of the universe. Ice cube in Antarctica is hunting neutrinos in the total “silence” of North Pole. Cherenkov radiation by neutrinos moving faster than the light in a medium can reveal secrets of our past. How this happens? How neutrinos are detected? Students are studying the physics of neutrinos, solving geometrical problems concerning Cherenkov’s cone and having a Hangout with researchers at the Ice Cube.
Activities
1.1: Organize into Groups
1.2: Presentation of the New Question/Problem
1.3: Discussion

Phase 2: Planning the Project
Activities
2.1: Discussion among the Group Participants

Phase 3: Doing the Project Work
Activities
3.1: Collection of Information
3.2: Synthesis of Information
3.3: Create Project

Phase 4: Presentation of the Outcomes
Activities
4.1: Project Outcomes Presentation
4.2: Discussion/Feedback

Phase 5: Assessing the Project Work
Activities
5.1: Summative Assessment

LanguageLanguage

English

Grade & AgeGrade & Age

Grade: informal context

Domain Domain

ICT>Ψηφιακά προιόντα>Εργασία με ψηφιακές κάμερες & βίντεο
ICT>Ψηφιακά προιόντα>Εργασία με φορητή ψηφιακή τεχνολογία
ICT>Πολυμέσα>Μετάδοση οθόνης
ICT>Λειτουργικές δεξιότητες>Αναζήτηση στο διαδίκτυο
ICT>Εργαλεία ΤΠΕ>ΤΠΕ εργαλεία: λογισμικό παρουσίασης
ICT>Εργαλεία ΤΠΕ>ΤΠΕ εργαλεία: παιχνίδια/προσομοιώσεις
ΤΠΕ σε δράση"
ICT>Αντίκτυπος ΤΠΕ>Σενάρια τι θα συμβεί αν"
ICT>Αντίκτυπος ΤΠΕ>Ανίκτυπος ΤΠΕ στην επικοινωνία
ICT>Έννοιες σχετικά με δεδομένα>Εικόνες: γραφήματα
Science>Αστρονομία>Astronomy>Σκοτεινή ενέργεια
Science>Αστρονομία>Astronomy>Σκοτεινή Ύλη
Science>Αστρονομία>Astronomy>Μεγάλη Έκρηξη
Science>Αστρονομία>Astronomy>Κοσμολογία
Science>Αστρονομία>Astronomy>Αστρονομία: Δημιουργία και εξέλιξη του Σύμπαντος
Science>Φυσική>Φυσική Υψηλών Ενεργειών>Σωματιδιακή Κοσμολογία
Science>Φυσική>Φυσική Υψηλών Ενεργειών>Παράμετροι σωματιδίων δέσμης
Science>Φυσική>Φυσική Υψηλών Ενεργειών>Καθιερωμένο μοντέλο
Science>Φυσική>Φυσική Υψηλών Ενεργειών>Επιταχυντές & Δέσμες
Science>Φυσική>Φυσική Υψηλών Ενεργειών>Επιτάχυνση φορτισμένων σωματιδίων
Science>Φυσική>Φυσική Υψηλών Ενεργειών>Ασθενείς αλληλεπιδράσεις: ηλεκτροασθενείς
Science>Φυσική>Φυσική Υψηλών Ενεργειών>Ανιχνευτές σωματιδίων
ICT>Πολυμέσα>Internet>Τεχνολογίες διαδικτύου
ICT>Πολυμέσα>Internet>Εργαλεία web 2.0
ICT>Πολυμέσα>Internet>Java

Teaching approachTeaching approach

Project-based learning aims at giving students a highly motivating learning experience, which is closely related to the tasks and challenges of the real world. Project-based learning also supports learning so called “adult skills”, which include skills such as working in teams, working in self-guided manner, and assessing of own actions. Project-based learning is also connected to the idea of attaining transferable skills such as problem solving (Helle et al., 2006).

The projects in Project-based learning are challenging and complex tasks that are based on some topics, questions, or problems that are driving the working in projects. Challenging and complex tasks means here that the tasks must be such that they cannot be accomplished successfully without new learning taking place. The projects at hand usually involve elements from various subjects, which make them multidisciplinary and not bound to any particular subject domain. The nature of the tasks have to be such that it involves learners in various kinds of activities that support the learning, such as designing, problem-solving, decision making, and active investigation. In projects, the learners work autonomously and collaboratively in small groups, whereas the teacher is more in a role of the tutor facilitating the learning process (Henry, 2005).

PhasesPhases

1.Definition of the Project Goal

Description of phaseDescription of phase

A new era in Astronomy and Cosmology raises. Neutrinos are gathering information from the cores of the stars, while travelling through the universe from the very beginning of the cosmos. Reaching Earth a shower of particles spreads all over the planet and scientists are hunting the “unsocial” neutrinos. Catching just one neutrino, important knowledge can be gained from the depths of stars and the initiatives of the universe. Ice cube in Antarctica is hunting neutrinos in the total “silence” of North Pole. Cherenkov radiation by neutrinos moving faster than the light in a medium can reveal secrets of our past. How this happens? How neutrinos are detected? Students are studying the physics of neutrinos, solving geometrical problems concerning Cherenkov’s cone and having a Hangout with researchers at the Ice Cube.

Learning activitiesLearning activities

1.1 Organize into Groups
Description: The teacher divides the class into groups of students and ensures that these groups consist ofstudents with different capacities.
Tools
Software Tools: Text, image, audio or video viewer
Hardware Tools: Computer, Projector

1.2 Presentation of the New Question/Problem
Description: 1. Teacher introduces students to theory of elementary particles, focusing in neutrinos. He presents to the students the following video from CERN:https://www.youtube.com/watch?v=V0KjXsGRvoA Then asks students about elementary particles and neutrinos2. Teacher also presents to students a video about a “telescope” buried in Antarctic ice that detects elusive neutrinos: http://www.telegraph.co.uk/science/space/10465749/Telescope-buried-in-Antarctic-ice-detects-elusive-neutrinos.html
Tools
Software Tools: Text, image, audio or video viewer
Hardware Tools: Computer, Projector

Resources

Educational objects (as file):
1. Pre-Experiment / Observation– Teaching Phase 1:Questions Eliciting Activities – PROVOKE CURIOSITY

Educational objects (as url):
1. Theory of elementary particles, focusing in neutrinos
2. “Telescope” buried in Antarctic ice that detects elusive neutrinos:

Duration: 1 Hours

1.3 Discussion
Description: Teacher reminds students of the breaking the sound barrier. Presents to them the following theory of physics: https://www.youtube.com/watch?v=-tpwj5rA-OQ Then, teacher presents the video “Cerenkov Light: What is it?” https://www.youtube.com/watch?v=x4Ir6E4IG64 asking students to find similarities between breaking the sound barrier and Cerenkov radiation.Teacher asks students to look at the geometry of the Cerenkov cone (shown in two dimensions at the inserted image).
Tools
Software Tools: Text, image, audio or video viewer
Hardware Tools: Computer, Projector

Resources

Educational objects (as file):
1. Pre-Experiment / Observation– Teaching Phase 1:Questions Eliciting Activities – DEFINE QUESTIONS FROM CURRENT KNOWLEDGE

Educational objects (as url):
1. The breaking the sound barrier
2. “Cerenkov Light: What is it?”

PhasesPhases

2.Planning the Project

Learning activitiesLearning activities

2.1 Discussion among the Group Participants
Description: Students discuss into the context of their groups about the project to be created and theresponsibilities of each group member. The teacher interferes to avoid possible misunderstandings..
Tools
Software Tools: Text, image, audio or video viewer
Hardware Tools: Computer, Projector

PhasesPhases

3.Doing the Project Work

Learning activitiesLearning activities

3.1 Collection of Information
Description: •Students are asked to use the HYPATIA software and simulate the experimental procedure of discovering the Higgs Boson. •This procedure reveals a way of “producing” neutrinos in colliders. •Teacher asks students about the energies of these “earthy produced” neutrinos.
Tools
Software Tools: Search engines VLEs
Hardware Tools: Computer

Resources

Educational objects (as file):
1. Pre-Experiment / Observation– Teaching Phase 2: Active Investigation – PROPOSE PRELIMINARY EXPLANATION OR HYPOTHESES

Duration: 1 Hours

3.2 Synthesis of Information
Description: •Students are attending a video from the ESA site about neutrinos emitted from the cores of stars and galaxies.Students are asked to use the MINERVA software in order to discover how new discoveries are made.We want to introduce students in research philosophy. Students can

thus realize the continuous efforts of finding new tools to research our world.
Tools
Software Tools: Text, image, audio or video viewer
Hardware Tools: Computer

Resources

Educational objects (as file):
1. Pre-Experiment / Observation– Teaching Phase 2: Active Investigation – PLAN AND CONDUCT SIMPLE INVESTIGATION

Duration: 1 Hours

3.3 Create Project
Description: •We communicate live with the scientists at the Ice Cube laboratory at South Pole via Google Hangouts. •Students are encourage to ask questions about the fundamental research and the basis upon neutrinos astronomy is developed.•How we detect neutrinos? Why we choose South Pole? •How can we “extract” information from neutrinos?
Tools
Software Tools: Word processor
Hardware Tools: Computer

Resources

Educational objects (as file):
1. Pre-Experiment / Observation– Teaching Phase 2: Active Investigation – PLAN AND CONDUCT SIMPLE INVESTIGATION

PhasesPhases

4.Presentation of the Outcomes

Learning activitiesLearning activities

4.1 Project Outcomes Presentation
Description: •We also connect with CERN and exchange information about neutrinos. •How can we distinguish neutrinos from space (stars) from neutrinos produced on Earth, at CERN for instance?•What are the values of energies of neutrinos produced at CERN and what are the energy values of neutrinos detected at Ice Cube?Then, students are asked to make assumptions about how can the released energy reveals information about stars and space creation.
Tools
Software Tools: Text, image, audio or video viewer
Hardware Tools: Computer, Projector

Resources

Educational objects (as file):
1. Experiment / Observation– Teaching Phase 4: Discussion – EXPLANATION BASED ON EVIDENCE

Duration: 1 Hours

4.2 Discussion/Feedback
Description: Furthermore we ask students to find out why we need neutrinos astronomy. What questions are left to be answered. Why Cosmologists need information from neutrinosStudents are asked to find how long does it take a photon to travel from the core to the outer part of a star. They can use the Sun4all software and the educational scenario “Sunspots! Let us introduce ourselves”.
Tools
Software Tools: Text, image, audio or video viewer
Hardware Tools: Computer, Projector

Resources

ODS educational objects (search):
1. Measurement Dimension of Sunspot

Educational objects (as file):
1. Experiment / Observation– Teaching Phase 4: Discussion – CONSIDER OTHER EXPLANATIONS

Educational objects (as url):
1. Educational scenario about Sunspots
2. Educational scenario about Sunspots

Duration: 1 Hours

PhasesPhases

5.Assessing the Project Work

Learning activitiesLearning activities

5.1 Summative Assessment
Description: Students can now explain why neutrinos are necessary for describing the physics of the inner part of the stars. Neutrinos are offering complementary information to astrophysicists•Even more students can distinguish low energy neutrinos “produced” on Earth from high energy neutrinos emitted from space objects. •Think of new possibilities at astronomy. Think of neutrino or other particles observatories.•Take part into a large project transforming the school roofs into particle detectors. •http://indico.cern.ch/event/99542/page/1
Tools
Software Tools: Text, image, audio or video viewer
Hardware Tools: Computer, Projector

Resources

Educational objects (as file):
1. Post-Experiment / Observation– Teaching Phase 5:Reflection – FOLLOW UP ACTIVITIES AND MATERIALS

Educational objects (as url):
1. Take part into a large project transforming the school roofs into particle detectors.