BRITEC – Bringing Research Into the Classroom

Learning Scenario

1. Title:

Radio Meteor Zoo

Author(s)

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Area of research

Study of meteors using reflection of radio waves on ionised air.

Subject(s)

Geography

Topic

Structure of the solar system – different objects in the solar system and their properties

Age of students

16-17

2. Introduction

Contribution of the CS project to Science in general

The Radio Meteor Zoo project aims to further the study of meteors. The goal is to create an independent computer system to scan data for meteors. The Royal Belgium Institute for Space Aeronomy (BIRA-IASB) has built a network of one transmitter (in the south of Belgium) and several receivers (scattered around the country). The transmitter sends out a steady radiosignal. This signal gets reflected by de ionised air that forms when a meteor passes through the atmosphere. The receivers then record the reflected signal. This system makes it possible to 'see' the meteors even during the day or when there is a heavy cloud cover. The problem is that, for now, the data has to be processed by people. The goal is to feed correct data (tracing of meteors on a sort of screenshot) to a computer algorithm so it can learn to discern the meteors without human intervention.

Aim of the activities plan and learning objectives

Structure of the solar system is part of the geography curriculum. The researcher covered a lot of the subjects (different objects in the solar system and their properties, position, …) during his lesson.

Due to lack of time and lack of enthusiasm (from colleagues, e.g. physics teachers) I don't think the students acquired any specific skills. The lack of time was partially caused by the corona-breakout though.

Summary of activities

Number of activity	Name of activity
1	Introduction to the project by S. Calders (researcher) (40 min.)
2	Identifying meteors in radio data during 1 geography lesson (45 min) (https://www.zooniverse.org/projects/zooniverse/radio-meteor-zoo)

3. Detailed description of each activity (to be completed as many times as activities are implemented)

First Part: Aim of the activity

- S. Calders introduced the project. The students got background information about the solar system and the various objects in the solar system. They learned the difference between comets and meteors, and how the two are also linked. They needed to understand how the meteors can be spotted using radio data and why using radio data gives us an advantage (you can spot meteors during the day or when there are lots of clouds). S. Calders also explained the importance of classifying as many meteors as possible by volunteers: the more correct data, the better the algorithm for identifying meteors on its own gets.
- Students identify meteors in radio data using a computer. The website offers enough explanation for the students to get started
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Second Part: Suggested procedure

Preparation time	Very little
Teaching time	40 min. / 50 min.
Online teaching material	https://www.zooniverse.org/projects/zooniverse/radio-meteor-zoo
Offline teaching material	None, it can all be done online.
Citizen science purpose of the activity (if any) *	Collecting data (identifying meteors from radio data) to improve the computer algorithm that learns to identify meteor signals from the spectrograms.
*** Guidance for teachers**	Most of the meteors that end up in the atmosphere are not visible to the eye because they are either too small or they are occurring

during the day or when the sky is cloudy. For this reason, scientists have developed a system with radio signals, that bounce back on the meteors (or rather: on the ionisation trail they leave in the high atmosphere). These signals are plotted in spectrograms, yet not every signal on those spectrograms represents a meteor. Sometimes there are signals from planes for example. Scientists want to analyse large datasets of meteor signals, to learn more about the outer space (e.g. when do most meteorites occur during the year? Are they different when a comet is nearby?). Because the datasets are so large, it is difficult for scientists to manually identify each and every meteor signal from the spectrograms, so they want to develop a computer algorithm. In order to increase the performance ('correctness') of the computer algorithm, it needs to be trained by us. Hence the need for people to manually indicate which signals are most probably meteor signals, and which are not. This is what we do with our students!

In terms of education, this project is great because it helps to hook the interest of the students and I can easily relate it to the content I have to give in my geography classes anyway (e.g. about the difference between meteorites, meteors and meteoroids, or about the solar system, comets, as well as observation techniques to study space.

Third Part: Advice on methodology

If I had more time, I would like to try and work together with other teachers (physics, math, chemistry) to make an integrated STEM-project. I would have liked to explore the background of the system more (Why do meteors ionize the air? Can we figure out the trajectory of the meteors from this data? …)

Another option (again with more time) would be to let the students themselves ask the questions and search for the answers, guided by the scientist and the various teachers.

Fourth Part: Educational analysis

Lifelong learning

STEM learning

Student based learning

Snack learning

4. Assessment after implementation of the activities plan

Student´s learning

Due to the restricted time, I didn't really asses the students. However, I evaluated the process: I wandered through the classroom, checking in with the students as they identified meteors, helping them if needed.

Another teacher, Wim Van Buggenhout, assessed the students in a more formal way, by giving them fill-in sheets, asking them to analyse at least 8 spectrograms per day during one week, and to go and search for information about comets, meteors, meteorites on the internet, in order to answer specific questions he asked them in his teaching materials.

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About the BRITEC project

BRITEC – Bringing Research into the Classroom project (https://britec.igf.edu.pl/) aims to introduce the Citizen Science (CS) approach in schools as a way of engaging pupils in research practices. This project has been funded with support from the European Commission within ERASMUS+ Programme and is coordinated by the Institute of Geophysics, Polish Academy of Sciences.