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The Space Science Suitcase—Instruments for Exploring Near-Earth Space from the Classroom

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Abstract The aurora and other phenomena in near Earth space are becoming a considerable part of the science curriculum in upper secondary school (high school) in Norway. Introducing scientific methods to the young students is an important objective of the education, but experimental experience is mainly restricted to simple laboratory exercises under controlled conditions; observations of uncontrollable natural phenomena are generally left to academic scientists and researchers. The Space Physics Group and The Science Education and Outreach Group at The Department of Physics and Technology, University of Bergen, are constructing a Space Science Suitcase with a set of simple versions of instruments for monitoring solar and geophysical activity in near Earth space. The instruments will be lent to physics classes in upper secondary schools.

Keywords Science curriculum · Space weather · Aurora · Ionosphere · Ground based observations · Public outreach

1 Introduction

In the knowledge promotion, the latest reform in the 10-year compulsory school and in upper secondary education and training in Norway, near-Earth space and radiation of different origins occupies a significant part of the science curriculum. In the chapter on Radiation and Radioactivity in the science curriculum for first year in Secondary Education Act the aims are formulated as follows[1]: The aims for the education are that the pupil shall be able to

– describe how the northern lights arise, and how Norway has been and is an important country for research in this field

[1] The Norwegian Directorate for Education and Training: http://www.udir.no/templates/udir/TM_Artikkel.aspx?id=2376

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- explain the importance of the ozone layer with respect to solar irradiation of the earth
- explain what the greenhouse effect is and elaborate on and analyse how human activities are altering the energy balance of the atmosphere
- elaborate on some possible consequences of the increased greenhouse effect, including in Arctic areas, and the measures that are being initiated internationally to reduce the increase in the greenhouse effect
- carry out experiments with radioactivity, half-life and background radiation and explain these phenomena
- describe characteristics of different types of ionising radiation and explain how these are used for technical and medical applications
- explain how electromagnetic radiation from space may be interpreted and provide information about space

Some of these topics are brought forward in the physics curriculum for the last 2 years of Secondary Education Act. The methods that physicists utilize in their studies of processes and natural phenomena is an integrated part of the education but traditionally, the majority of practical exercises in schools are carried out under controlled conditions in a laboratory. One of the purposes of the Space Science Suitcase is to offer the students an opportunity also to study phenomena such as the space weather that are controlled entirely by nature itself and to gain some experience in interpreting the results.

2 The Contents of the Suitcase

The suitcase will be equipped with robust and user friendly commercially available instruments in the lower price range. The basic outfit in the beginning will consist of:

- A simple solar telescope (Sunspotter) for white light for observing sunspots, and a narrow-filter telescope for the H-alpha line (656.3 nm).
- A tri-axial magnetometer for monitoring ionospheric currents.
- A simple VLF-receiver. VLF-waves are easy to receive, but in general difficult to interpret. However, some emissions such as whistlers or auroral chorus are rather easy to recognize.
- A Geiger counter for monitoring background radiation/cosmic radiation.
- A commercial SLR digital camera (Canon EOS 400D) with a fisheye lens for photographing the aurora.
- A laptop for controlling the camera and the magnetometer, and collecting the pictures and measurements from the instruments.

3 Using the Instruments

The suitcase will be lent to physics classes in the last year of upper secondary schools for a few weeks at each school, allowing the students to do their own quantitative observations of sunspots, magnetic disturbances, VLF-emissions, optical aurora and background radiation. Comparison of these observations with online observations from scientific observatories and satellites is an integrated part of the project. An introduction relating the observed parameters to phenomena in the solar wind and near-Earth space will be written. The project of each class will be concluded with a presentation and evaluation.

4 What do we want to Attain?

The overall purpose of the project is to promote scientific literacy and bring excitement about space phenomena into the classroom. The progress of basic science in the coming decades depends to a large extent on the youths curiosity for nature. We hope that the Space Science Suitcase will also be a valuable agent to recruit eager students to university studies in the physical sciences in general and space science in particular.