Rewarding Learning

Teacher Guide

Unit 8

Remote Sensing of Earth and Space

For first teaching from September 2013
For first assessment from Summer 2014

For first award in Summer 2014

space science technology

Level 2 Certificate

UNIT 3: Technology Impact on Society

Teacher Guide Unit 8

space science technology

UNIT 8: Remote Sensing of Earth and Space

Learning Outcome 1: The learner will understand the general concepts behind remote sensing of the earth, and its potential value

The learner can:

1.1: Describe how satellites are used to sense, store and transmit information about the earth's surface back to users on the earth

- Satellites used for remote sensing generally are not equipped with conventional cameras; instead they measure reflected light with electronic sensors (radiances). The light-sensitive elements convert this light into electrical signals and are converted into a stream of zeros and ones which are beamed down to receiving satellite dishes on the earth's surface.
- Each satellite generally uses a number of electronic sensors, allowing different wavelengths to be observed. Each wavelength will allow different information to be gathered, making the sensed image more useful.
- When the digital streams are processed back on the earth, the strings of digital data are translated back into the original light values. The different wavelengths are then combined in various ways to rebuild the images. As the sensors can sense light that the human eye cannot detect, false colours can be given to some wavelengths to allow us to see and interpret the images.

1.2: Investigate the uses and value of remote sensing of the earth

- Using space-based earth observations to observe geohazards such as earthquakes, volcanoes, landslides, drought and flooding. The potential of remote sensing in providing warnings before the event and the value of it in providing information after the event can be investigated
- Remote sensing's application for agriculture in providing data about potential crop yields, and threats to agriculture through pests, diseases and droughts can be explored
- The role of remote sensing in contributing to knowledge of earth geology, supplementing the work of geologists on the ground with the potential for the identification of mineral deposits can be researched.
- The role of remote sensing in environmental protection which might include providing information on deforestation, changes in sea temperature, changes in ice extents at the poles, monitoring of coral reefs or other environmental sensing
- Understand the value of false colour or infra-red sensing in order to emphasise certain features. A false-colour image uses colours other than

those which we detect with our eyes (true-colour) so that features that cannot or cannot easily be seen otherwise. Using false colour which is near infrared will show up vegetation in satellite images much more effectively than using true-colour.

- Remote sensing is often faster than collecting data on the ground and can happen without disturbing what is being sensed.
- Candidates should produce a digital artefact summarising the value of remote sensing. This could be a poster, a presentation, a flyer or another digital asset which conveys the potential of remote sensing of the earth

Learning Outcome 2: The learner will understand the general concepts behind remote sensing of the objects in space other than the earth, and its potential value

2.1: Investigate the reasons for remote sensing of objects in space, other than the earth

- Candidates can explore how remote sensing can increase our understanding of how the solar system evolved
- Candidates should be able to explain how remote sensing can be used to compare our planet with other planets, so that we understand the Earth better, and the processes that operate in the universe

2.2: Investigate how remote sensing can be used to observe objects in space, other than the earth

- Using space-based observations of objects in space other than the earth to study the geology of those objects. This is the study of surface and interior processes on any solid objects in the solar system: particularly planets, asteroids and comets. Most of what we know about these objects comes from remote sensing, as people have not visited them. Some information has been gleaned from meteorites and samples of cosmic dust, and many observations have come from ground-based telescopes. However, many of the satellites in orbit around the earth are fitted with telescopes, specialist cameras or spectrometers, providing even more evidence.
- Candidates should be able to describe some of the range of techniques used in remote sensing of objects in space other than the earth. These include:
  a) Measuring the density, shape, size and mass of solid objects, and examining surface features. This is done by getting images of objects using visible, thermal or radar sensors. Lasers can be used to prove detailed measurements of the surface of the planets, and the changes in

radio signals from spacecraft as they pass close to objects also provides much information.

b) Planetary surfaces can be examined to provide suggestions as to what geological processes have been in action on a planet. Most examinations use images taken by sophisticated cameras, but some planets are covered in clouds and so radar has to be used. These allow geological maps of the planets to be drawn,

c) The ages of the surface rocks can be guessed at by space geologists, particularly using the number of craters caused by objects crashing into the surface. In simple terms, smaller number of craters means younger features, while lots of them means older.

d) An idea of the surface composition of planets and other bodies can be found suing spectroscopic analysis of the sunlight reflected from the surfaces, the thermal emission in Infrared or an examination of the rays which the surface and which lower layers give off.

e) The atmosphere can provide evidence for what the surface of the planet is like. Atmosphere can be examined using a wide range of remote sensing techniques

Some useful approaches to teaching Remote Sensing can be found at http://landmap.mimas.ac.uk/index.php/Learning-Materials/Spatial-Science-for-Schools/Home Included are a range of teaching examples from five subject areas: Geography, Biology, Maths, Physics and Geomatics which are worth exploring. In the Geography section, the examples on floods, tsunamis and oases seem particularly appealing. Each 'course' has to be downloaded and unzipped before use. Some require additional software, such as Google Earth, to run.