RADIATION LEVEL

INTRODUCTION

Our next challenge was to build a robot device in order to transport the rocks found on the planet to the station. Here, the rocks were labeled and the scientist measured the radiation level. The measurements concerned the emission of alpha, beta and gamma radiation. We already know that radioactive elements such as uranium and thorium decay naturally to form different elements or isotopes at the same element. This decay is accompanied by the emission of radiation of these particles (alpha, beta, gamma rays) from the nucleus, by nuclear captures or by ejection of orbital electrons.

Because of the narrow range of absorption, alpha rays are not generally dangerous to life unless the source is ingested or inhaled, in which case, they become extremely dangerous. Because of this high mass and strong absorption, if alpha emitting radionuclide does enter the body, alpha radiation is the most destructive form of ionizing radiation. It is the strongest ionizing, and with large enough doses can cause any or all of the symptoms of radiation poisoning.

Beta rays are much lighter energy particles. The beta particle is an energetic electron given off by the nucleus of unstable isotopes to restore an energy balance. They leave the nucleus at a speed of 270,000 kilometers per second. Weaker beta particles can be detected through the tube window. Although the beta particle is around 8000 times smaller than the alpha particle, it is capable of penetrating much deeper into living matter. Each encounter with a living cell, and there may be many before the beta energy is dissipated, is likely to damage some of the chemical links between the living molecules of the cell or cause some permanent genetic change in the cell nucleus. If the damage occurs within the generative cells of the ovaries or tests, the damage may be passed to new generations. The normal background radiation level must contribute to the mutation of the gene pool. Most mutations are undesirable with a very few leading to "improvements". Any increase in the background level of radiation should be considered harmful.

Gamma rays are more penetrating then the other two, causing diffuse damage throughout the body, increasing incidence of cancer rather than burns. The most biological damaging forms of gamma radiation occur in the gamma ray window, between 3 and 10 MeV, with higher energy gamma rays being less harmful because the body is relatively transparent to them.

OBJECTIVES

In this project, we will:
Use a Vernier radiation monitor to measure radiation level.
Build a robot device to transport the rocks.

MATERIALS

computer
LEGO NXT Intelligent Brick
LEGO MINDSTORMS NXT Educational Set
MINDSTORMS Edu NXT v2.0 software
Vernier radiation monitor
a set of rocks

CONSTRUCTION

Our robot will travel on the planet, take the rocks in a trailer and carry them one by one to the station. An example is shown below.

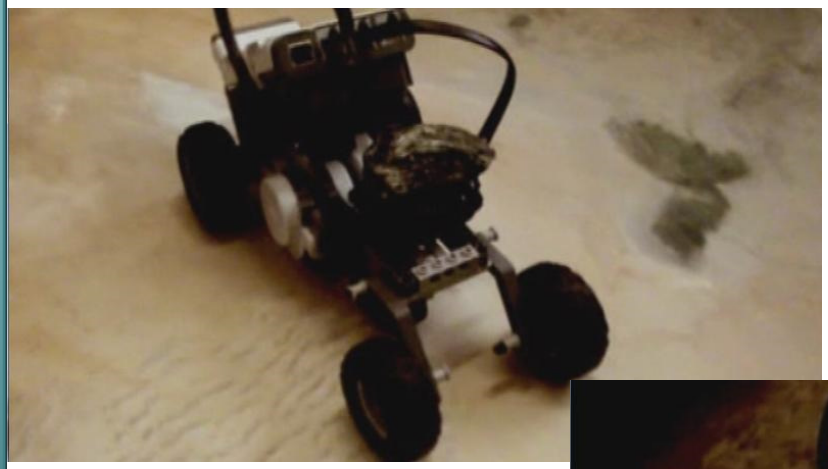
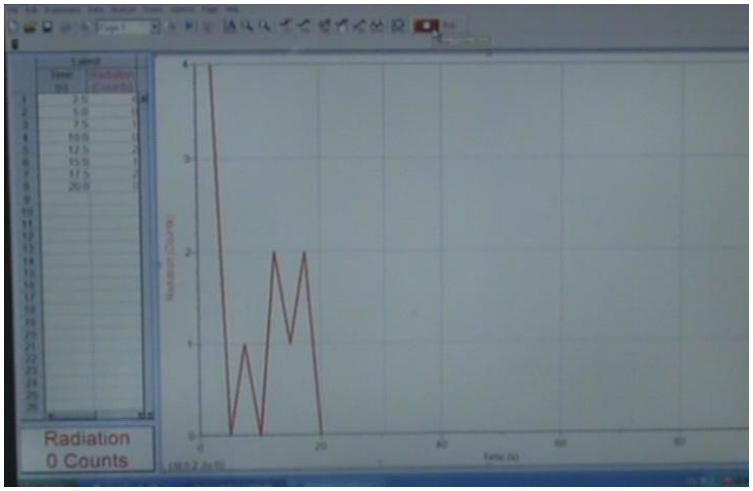


Figure 1 The robot device "looking" for rocks, on the planet

Here the radiation level is measured using a digital radiation monitor. This instrument is used to monitor alpha, beta, and gamma radiation. It can be used with a number of interfaces to measure the total number of counts per specified timing interval.

The Radiation Monitor senses ionizing radiation by means of a Geiger-Mueller (GM) tube. The tube is fully enclosed inside the instrument. When ionizing radiation or a particle strikes the tube, it is sensed electronically and monitored by its own display, a computer, or by a flashing count light. It is calibrated for Cesium-137, but also serves as an excellent indicator of relative intensities for other sources of ionizing radiation. Gamma radiation is measured in milli-Roentgens per hour. Alpha and beta are measured in counts/minute (CPM).



Here we present the radiation level for rocks found on the planet.