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# Experiments measuring surface rocks and soils characteristics by Hunveyor - Husar educational space probe models in Hungary.

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**Introduction:** We report about 3 planetary surface analog experiments on the soil and rock surface of a planet by the Hunveyor-Husar educational space probe systems [1-3] in Hungary. We studied (1) The experiment with magnetic dust observation on a carpet containing small discs of magnets, (2) the experiment to measure the pH of the soil on the surface using the indicator method, and (3) the identification of the rocks along the rover's path on the basis of the shape, color and surface texture of the rock samples.

**Magnetic dust observation on a carpet at Hunveyor 9:** Between two sheets (of paper or textile) magnetic discs (or squares) were fixed in a pattern. On the surface of the carpet the magnetic attraction causes adherence of any magnetic component of the dust. The adherence becomes visible by dust colouring the surface of the sheet above the magnetic discs (Fig.1.). Similar experiment was carried out on Mars Pathfinder [4-6].

*Fig. 1. Magnetic experiment in the lab. dispersing the mixture on the magnetic carpet (here white sheet) the magnetic component of the dust adheres above the magnetic squares.*

**Changing parameters in the dispersing experiment:** There were two changing parameters in this experiment: the mixing ratio between iron and sand, and the slope of the carpet.

Earlier we prepared 4 type of mixtures of sand and iron-filings. A. was the mixture of 1 weight percent of iron-filings and 99 % of sand. B. was the mixture of 5 weight percent of iron-filings and 95 % of sand. C. was the mixture of 10 weight percent of iron-filings and 90 % of sand and D. was correspondingly 20 weight percent of iron-filings and 80 % of sand.

In the experiments we used 3 different positions of the carpet depending on the conditions how it is sloped out from the Hunveyor-9 frame, when it was rolled out down to the soil: 1) on smooth flat carpet, 2) a small angle (gentle) aslope carpet, 3) a high angle aslope carpet. [7]

*Fig. 2. Experiment arrangement with early version of Hunveyor-9. This position of the carpet is in a gentle slope. The magnetic carpet here is a white sheet with patterned magnet squares fixed inside the carpet.*

**Experiment for pH measuring by a rover (Husar-5):** The principle of the classical experiment is that a liquid can wet the indicator ribbon and the changing color indicates the pH value of the liquid. If water is poured to the soil surface it dissolves important chemical components from the soil and the indicator ribbon reports the main chemical characteristics of this chemistry. For a field-rovering car model we constructed two arms and a pump (both from LEGO elements in the Mindström system). On the first arm the wireless camera was placed, which could rotate around 360°-and also could bend down. The role of the second arm was to stretch and place the indicator ribbon to the surface and move it along a distance to contact with the wet soil. The role of the pump was to pour water on the soil surface [8].

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**Description of the experiment:** The rover continuously observed the rocks on the surface in front of it. (controlled by the ultrasonic sensor) The camera gave detailed panorama of the surface in front of the rover. Moving forward the pump poured water for 15 seconds on the soil bottom of the rover. (This place was earlier observed by the camera.) The rover returns back from the wet surface, and goes forward again with the second arm to touch the surface to contact it with the indicator ribbon. The first arm brings the indicator ribbon to the view of the camera to observe the color of the indicator ribbon. The program compares the color with standards and determines the pH value of the soil.

*Fig. 3. Pouring water, the indicator arm touch the soil. Indicator ribbon arm rolls the ribbon. Husar moves backward to prepare observation of the rolled indicator surface, which holds the information about the pH of the soil. The result of the experiment on the indicator ribbon is transfered by the camera.*

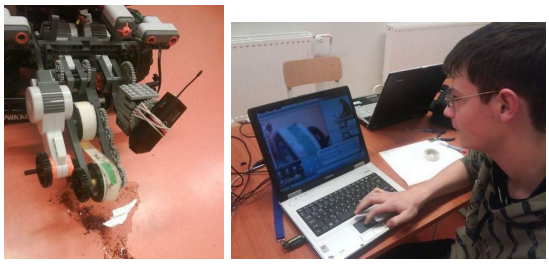

*Fig. 4. Control room student observes on the screen the measured color, and he can compare the measured value with the standard color set of the pH-values. (Languages: Labview: on the terrestrial control computer, MSWLogo: for the transliteration of color to pH-value.)*

**Rock types along the path of the Husar:** We studied the rock types along the Husar rover's path and identified them on the basis of their shape, color and surface textures [2]. A camera was mounted on the rover with ability for rotation. The camera was directed form the "terrestrial control room" of Hunveyor. We directed the images toward the control room and to the Hunveyor lander, too. The camera observed the landscape in front of it and stopped at an interesting object. The rock was imaged and walked around during studies of that rock. We mapped the rover's path in order to return there at a later activity.

This experiment also served the learning the identification of rocks. Students get acquainted with several new rock types, and also collected rocks from the country to give a rich landscape to the rover. We also selected those rocks which can be recognized by characteristic surface texture. The shape, color and surface texture were the three main characteristics in their identification.

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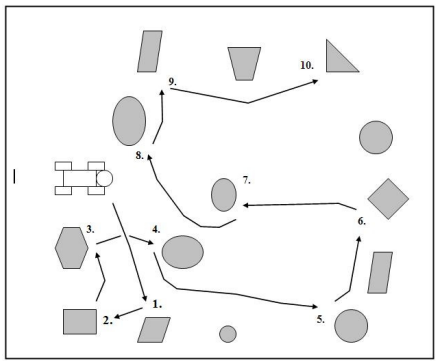


*Fig. 5. The pathway of Husar on the test table between the planetary rock types.*

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