

## Abstract

The Italian national project *Piano Lauree Scientifiche* (PLS) [1] is addressed to high school students in order to promote their interest in physics and science with the aim of increasing professional vocations and enrollments in scientific faculties.

In the PLS framework, at Roma Tre University we developed an itinerant educational laboratory based on meteorites analysis by means of a portable kit. The activity is performed at school and the students are directly involved in the study of meteorite features and in measurements of physical properties of the samples. Students are intriguingly introduced in the scientific method working together in acquisition and analysis of data, and writing a final report.

Lessons and laboratories were developed in collaboration between researchers and high school teachers.

Thanks to their multidisciplinary character the activities represent an excellent tool for stimulating the interest in different fields of science as astronomy, physics, geology and biology.

## Project outlook

### Non-formal lessons

The theme of meteorites is explored through non-formal lessons. Students are introduced in the knowledge of meteorites. Some physical quantities that will be analyzed in the laboratory are recalled.

**Lesson 1:** Origin, classification of meteorites [2, 3]. Finding meteorites. Simulation of density stratification. Research of terrestrial impact craters by Google Earth.

**Lesson 2:** Density and conductivity of materials. Impacts and craters formation.

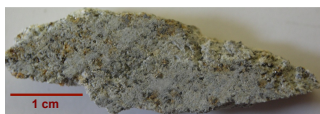
### Laboratories

During hands-on activity, working in team students perform measurements of meteorite properties, learning the scientific approach, and discussing results in their classroom [4, 5].

**Laboratory 1:** Density measurements on meteorites and experimental comparison with terrestrial materials.

**Laboratory 2:** Conductivity measurements on meteorites and experimental comparison with terrestrial materials.

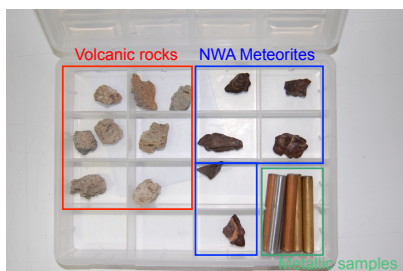
**Laboratory 3:** Production of a simple model of impact, study of craters and distribution of the ejecta.



Sample of the Italian Alfianello meteorite.



Cleaning a siderite with Nitol solution to obtain the Widmanstätten pattern.

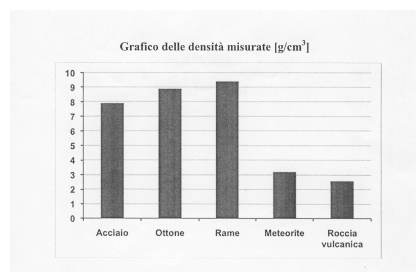


Samples kit for density measurements.

## A guided discovery learning

By means of amusing and involving laboratory experiences, we were able to perform the activities at different level of high school. Depending of the age of students (from 14 to 18) concepts were proposed with the proper degree of complexity in order to maintain interest and vividness in the activities.

The *guided discovery learning* approach we adopted has been proved very efficient in order to catch the target of a significative learning.



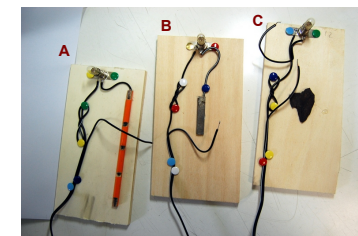
Density plot obtained by students.

We perform simulation to study the difference between vertical and grazing impacts, and the dispersion of ejecta.



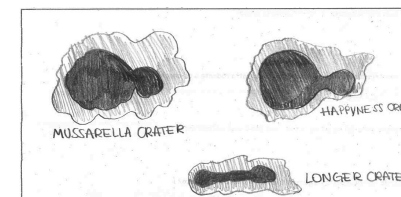
Simulations of impact craters. Materials used are sand and flour.

We realized simple electric circuits, to introduce students in the Ohm law and perform measurements to discriminate the difference between conducting and insulating material. Meteorite samples showed properties similar to many materials present on the Earth.



Electrical circuits for resistivity measurements:

- A. Graphite pencil;
- B. Siderite;
- C. Chondrite.



Craters sketches performed by students.

## References

- [1] <http://www.progettolaureescientifiche.eu>.
- [2] McSween H.Y. Jr. 1999, "Meteorites and their parent planets", Cambridge University Press.
- [3] Norton O.R. 1994, "Rocks from the space: meteorites and meteorite hunters", Mountain Press Publishing Company.
- [4] NASA, "Exploring Meteorite Mysteries", <http://er.jsc.nasa.gov/seh/meteoroslides.pdf>.
- [5] NASA, "Planetary Geology", [http://www.nasa.gov/pdf/58263main\\_Planetary\\_Geology.pdf](http://www.nasa.gov/pdf/58263main_Planetary_Geology.pdf).