

## **Food Sauces to Understand Volcanoes: a Learning Sequence in Middle School**

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Some volcanic processes occur at pressures and temperatures very different from daily experience. Such extreme conditions, unreproducible in the classroom, can lead children to build concepts about volcanic phenomena very different from the reality (Greca & Moreira, 2000; Dove, 1998). The didactic goals of this learning sequence concern the relationships between the viscosity of magmas and types of erupted materials and their consequences on volcano shapes, to favour pupils' comprehension of what a volcano is. Viscosity and its temperature dependence can be easily experimented in class with analogue materials at room temperature (Baker et al., 2004). Our research aims are to observe the development of the thought of pupils of middle schools on volcanic phenomena; this allowed to put in evidence the benefits of this approach and to give suggestions to avoid possible critical points. We have experimented a hands-on learning sequence about volcanoes in four third classes of Tuscan middle schools, for an amount of 95 pupils, 48 females and 47 males. Sharing the principles of constructivism, we think useful that pupils start from their own direct experience for understanding natural phenomena not directly observable. Therefore, we start from the experiences and knowledge of children to build a inquiry-based itinerary (Minner et al., 2010; Pieraccioni et al., 2016). The learning sequence begins with a practical activity in which we employ common and well-known materials to introduce the concept of viscosity in order to relate various kinds of magma to the shape of volcanoes.

One of the benefits of this approach is to overcome the problems of introducing complex concepts such as acidity of magmas or silica content, far from the pupils' experience and knowledge. These concepts are often used in Italian middle school textbooks to describe and classify volcanoes. The result is a list of names to learn by heart. On the contrary, by using oil, ketchup, peanut butter or honey, pupils become familiar with concepts such as viscosity, behavior of fluids, magma, lava, slope of flanks and they can begin to comprehend why volcanoes have got differently named forms.

### **REFERENCES**

- Baker D.R., Dalpè C. & Porier G. (2004) - The Viscosities of Food as Analogs for Silicate Melts. *Journal of Geoscience Education*, 52, 363-367.
- Dove J. (1998) - Students alternative conceptions in Earth science: a review of research and implications for teaching and learning. *Research Papers in Education*, 13(2), 183–201.
- Greca I.M. & Moreira M.A. (2000) - Mental models, conceptual models, and modelling. *International Journal of Science Education*, 22(1), 1–11.
- Minner D. D., Levy A. J., & Century J. (2010) - Inquiry-based science instruction—what it is and does it matter? Results from a research synthesis years 1984 to 2002. *Journal of Research in Science Teaching*, 47(4), 474–496.
- Pieraccioni F., Finato B., Bonaccorsi E. & Gioncada A. (2016) - The soil in the classroom: a middle school case study. *Educational Journal of the University of Patras UNESCO*, 3(2), 149 -157.