

# **Learning about the Complexity of Nature by coaching young students in the field of scientific research**

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## **Abstract**

The latest developments of the computing & IT methodology, of the nonlinear models & theories, and of the structuring of research networks at international level allow a better approach to and further understanding of the natural phenomena, particularly those related to Life, Environment and Human Factors. The knowledge and data accumulated in different research fields as a result of international and/or interdisciplinary cooperation can be used set up a conceptually novel framework within which one can act and approach problems much more efficiently and according to environmental principles. This new approach is known as The Science of Complexity, and has been developed and promoted by prestigious academic and scientific personalities, such as Ilya Prigogine, Benoit Mandelbrot, Rene Thom, Per Bak, David Chalmers, who worked either independently or in interdisciplinary institutions, e.g. the renowned Center in Santa Fe, New Mexico, USA.

In Romania, the Complex Systems are studied only in small isolated islands in some academic centers (in a few faculties within the Universities of Bucharest, Timisoara, Suceava) as well as in some departments of a few research institutes. Indeed, an specialized Romanian institution dedicated exclusively to the thorough and professional study of this highly specialized field exists only since 1996, when the Center for the Science of Complexity (CSC) has been founded to research, develop and promote the dissemination of scientific knowledge related to this field to various audiences.

Following and resulting from the activities carried out in the period 1996 - 2000, CSC launched in March 2000 the NEXUS - T program that was set to structure and develop a suitable environment for work and creativity, i.e. capable to awaken and expand the specific skills and abilities required in creation, innovation and research, particularly among the teenagers. Furthermore, it is also meant to encourage the inherent curiosity spirit, the analytical attitude and to actively promote independent thinking as well as redefining the concept of "work" in interdisciplinary teams. An additional purpose implied publicizing the scientific results in the framework of some dedicated summer schools (Fractal 'xx and Atlanykron - a little island on the Danube river near Capidava).

The NEXUS-T project starts from the premise that a well-asked question can initiate a specific cognitive process, able to arouse interest and curiosity and to motivate the effort of accumulating knowledge. For this reason, the program was conceived to stimulate young people's ability to generate pertinent questions in the field of Complexity Science that would find their answers through a process largely based on self-instruction, experimental research and intra- and Internet communication with other students interested in the same topic.

This project is specifically addressed to the following audience(s):

- Ph.D. students, professors, researchers (over 25 years old) -

- o design & management of experiments around the "good questions" generated in the first step of the project by the High school/college students,
- o teaching and coaching,
- o writing the final report,
- o promoting teamwork and their research topic and the obtained results.
- Students up the M.Sc. level (between 20-25 years old) -
- o design and implementation of an experimental set-up of the Complex Teaching Object (CTO) - a hard/soft ensemble that allows experimental, multidisciplinary exploration of the processes and phenomena of interest, according to the topics established in the first stage of the program,
- o processing and interpreting the gathered data,
- o writing the final report,
- High school/college students (between 15-18 years old) -
- o as observers,
- o direct participants in documentation, data gathering and then synthesis in the elaboration of a final presentation,

This paper presents the methodology used in the Nexus -T program, some observations and results after 4 years of activity in a Romanian high school. The presentation includes also the description of the CONNECTUS concept: a Personal Laboratory ...linked to a Personal Computer.... linked to Internet is a good framework for a home research activity that can expand the personal knowledge and develop the abilities to understand and respect the Nature.