



## Complexity pays

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TITLE: COMPLEXITY PAYS!

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I had the idea to work on the complexity of micro and macrostructure of some life forms to participate with my students at the “Darwin Day” event in Ancona, on February 2009, the 12th.

We made comparison between folded structures inside micro (organelles and cells) and macrostructures (humans organ)

After the “Darwin Day” event I have presented this topic on at least two other occasions:

- as lessons about the Darwin Theory to primary school students in Ancona (from January to May 2010);
- at the end of an ISS tutor training course in Rome on April 2010.

The aim of this work is to demonstrate that the analogy between folded microstructures and folded macrostructures could be a good methodology to approach the biological studies “from the general to the particular” (deductive method).

Infact, folded structures have solved a lot of problems in the evolution life. If we think about our body:

[U+F0D8] the intestine is folded to host 8 meters of tube in the small volume of the stomach cavity, otherwise in order to digest we would have to be more than 8 meters tall! It would be difficult for us to walk as we usually do!

[U+F0D8] the brain is also folded in the skull, otherwise our head it could be big as a cape!

In the same way micro-folded structures are present in:

[U+F0FC] the internal membrane structure of some organelles (mitochondria and chloroplasts);

[U+F0FC] the membranes of Golgi Apparatus and of the Reticulum Endoplasmic are folded

Furthermore macro-folded structures are represented by the suture line of the Ammonites, the best known Jurassic fossils in my country; it's curious that the spiralling of the ammonite shell became more complicated with time, except towards the end when they became extinct.

Finally the internal structure of our bones is complex, similar to that a sponge.

To understand this module the students need to know and understand:

- the endosymbiotic theory of Lynn Margulis;
- the advantages of endosymbiosis phenomena in the evolution of life;
- the utility of folded structures in our life.

At the end of the topic the students should be able to see the relationship between the major geological events and the evolution of life, linking them with the complexity of the micro and macrostructures observed (for instance they could observe the change of the spiralling of the ammonites just before their extinction, 66 million of years ago).

To better understand the phenomena we could devise videos in which students and the teacher simulate processes that happened in nature billions of years ago.

To stimulate students to this approach we could organize a day-trip looking for Ammonites in the “Jurassic submarine park” in the Marche region and looking for the K-T boundary in the Gola del Bottaccione, next to Gubbio (Umbria region). This year there is also a “Dinosaurom show” in Gubbio, organized by the American Museum of Natural History of New York.