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Digital Resources to Enhance Creative Mathematical Thinking in a Biomathematics Context

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Introduction

Promoting Creative Mathematical Thinking (CMT) to enable innovation is a central goal of European Union. CMT is a highly valued asset in industry and addresses current and future economic challenges. It is seen as an individual and collective construction of mathematical meanings, norms and uses in novel and useful ways, which can be of relevance to a larger (academic, learning, professional, or other) community. Exploratory and expressive digital media created by new designers are providing users with access to and potential for engagement with CMT in unprecedented ways.

A new kind of digital resource, a c-book unit ("c" for creative) designed within the MC Squared project (http://mc2-project.eu) is a digital book produced within a socio-technological environment called "C-book technology". It allows meshing narratives with interconnected interactive dynamic digital artefacts, called widgets, to promote students' CMT.

The Math for Biology c-book Unit

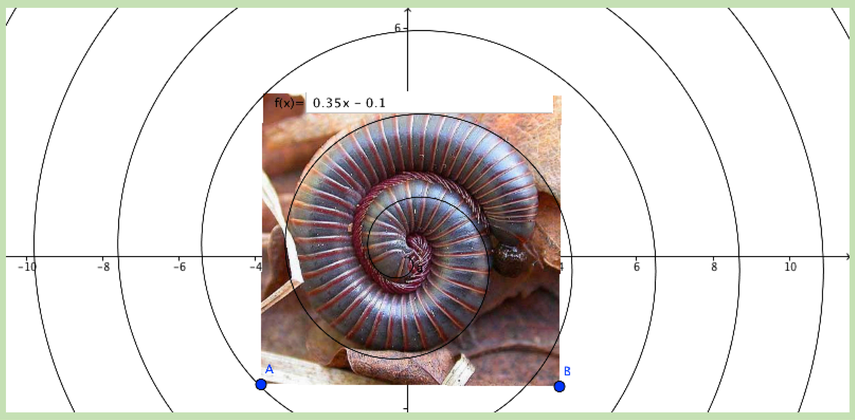
The "Math for Biology" c-book unit is produced by the French Community of Interest (CoI) gathering mathematics teachers, teacher educators, computer scientists and researchers in mathematics education. It proposes a sequence of activities within a biomathematics context aimed at enhancing CMT using a wide range of widgets useful in biology. Hany and El-Demerdash (2015) assert that biomathematics is a good educational medium context to enhance CMT.

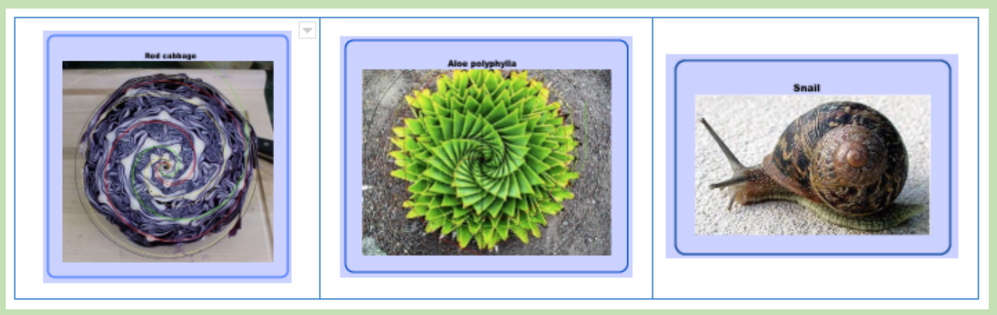
The c-book consists of four sections: The first is an introduction to biomathematics, its meaning and its study fields. In the second section, mathematics is used to model biological traits, leading to a reflection on magnitudes. Golden ratio is studied in the third section, its occurrences in nature, paintings, architecture and Fibonacci numbers. The c-book unit ends with the analysis of spiral images uploaded by students themselves, and allowing them to build their own artwork.

Widget Instances and CMT Enhancement

This c-book unit embeds many widgets that propose open-ended activities to train a high degree of CMT such as reflecting on models, modelling spirals and code tweaking in a half-baked logo microworld. In this poster, three examples of these widgets are presented.

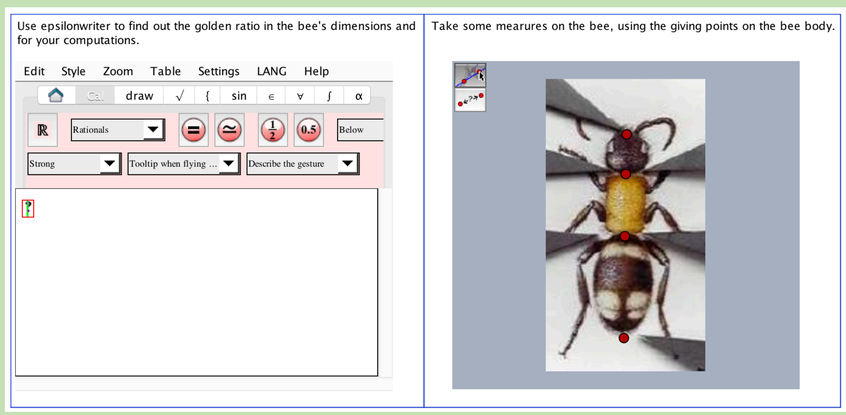
[1] DGS widgets enabling students to upload their own spiral pictures and try out some formulae that fit them.



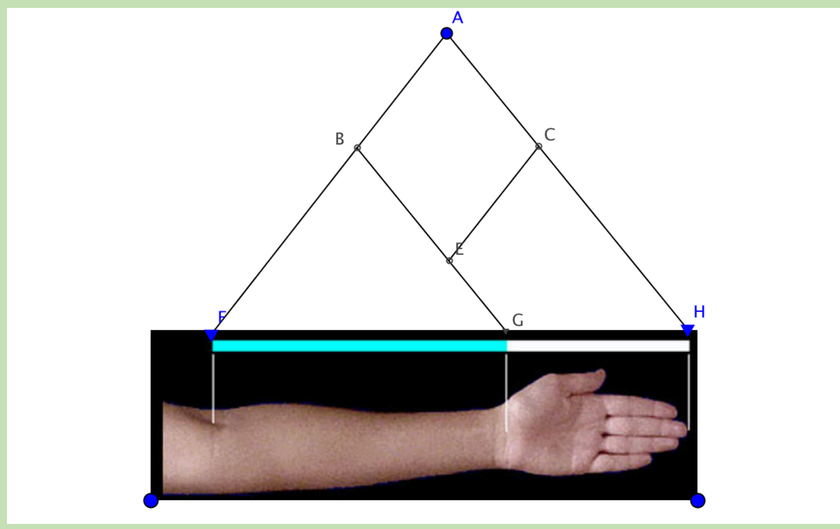


Using these widgets, users have the opportunity to look for many different and varied examples of spirals to look for models and formulas. CMT is fostered mainly in the direction of fluency and elaboration because the students have to come up with many different trials that go deeper into refined details.

[2] The cross widget communication between Cinderella[1] and EpsilonWriter[2] (DAS) allows sending messages between the two software factories (a widget factory is a software system - often developed independently of the c-book environment over many years - allowing to produce sophisticated parameterizable c-book widgets easily. This widget sends the measurements from Cinderella widget to EpsilonWriter where users can write text and mathematical content, as well as doing calculations, in particular comparing the ratio of values.



[3] The digital golden ratio compass tool is a DGS widget enabling users to discover proportions seemingly like golden ratios in other context such as in insects, and in plants, artwork, etc. Users look for a picture of an object, upload it and check with the digital compass whether its dimensions satisfy the golden ratio.



References

Hany, M., & El-Demerdash, M. (2015). The effectiveness of a proposed unit in Bio-Mathematics for developing secondary stage students' deep understanding skills - in Arabic. *Egyptian Association for Science Education Journal, 18(5)*.

[1] http://www.cinderella.de

[2] http://www.epsilonwriter.com