



The
Fibonacci
Project

DISSEMINATING INQUIRY-BASED SCIENCE
AND MATHEMATICS EDUCATION IN EUROPE

THE FIBONACCI PROJECT PRESENTATION BOOKLET



WITH THE SUPPORT OF



Why Fibonacci ?



Leonardo of Pisa (c. 1170 – c. 1250), or, more commonly, **Fibonacci**, was an Italian mathematician, considered by some as the most talented mathematician of the Middle Ages. In his book, the Liber Abaci, he posed and solved a problem involving the growth of a hypothetical population of rabbits based on idealised assumptions. Suppose a newly-born pair of rabbits, one male, one female, are put in a field. Rabbits are able to mate at the age of one month so that at the end of its second month a female can produce another pair of rabbits. Suppose that our rabbits never die and that the female always produces one new pair (one male, one female) every month from the second month on. How many pairs will there be in one year? The solution, generation by generation, was a sequence of numbers later known as Fibonacci numbers: the number of existing pairs is the sum of the two previous numbers of pairs in the sequence: **1, 1, 2, 3, 5, 8, 13, 21...**

We chose this sequence to illustrate how a massive dissemination project in Europe can be conceived and planned, starting from a limited number of **Reference Centres for science and mathematics education**, which have been given the objective of raising the capacity of other centres in Europe to become themselves reference institutions for inquiry-based science and mathematics education in a given time. Reproducing this process from a new born Reference Centre, we can expect an iterative growth similar to the Fibonacci sequence.

Fibonacci has received endorsement or expressions of interest from the following prestigious scientific bodies:

The Academy of Athens • The Berlin-Brandenburg Academy of Sciences • The Bulgarian Academy of Sciences • The Finnish Academies of Sciences and Letters • The French Academy of Sciences • The Romanian Academy • The Royal Society (UK) • The Royal Irish Academy • The Royal Netherlands Academy of Arts and Sciences • The Royal Swedish Academy of Sciences • The Serbian Academy of Sciences and Arts • The European Science Education Research Association (ESERA) • The European Space Agency (ESA) • The International Research Group on Physics Teaching (GIREP) • The InterAcademy Panel on International issues (IAP)

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« The best way to learn is to do - to ask, and to do. The best way to teach is to make students ask, and do. Don't preach facts - stimulate acts »

Paul HALMOS, Hungarian-born American mathematician.

« One has to guide the pupils and not impose the truth upon them »

Georges CHARPAK, 1992 Nobel Prize in Physics.

This booklet provides a general presentation of the FP7 Fibonacci Project for education authorities, decision-makers and other interested groups.

Fibonacci is a European research and development project supported by the DG Research of the European Commission. As such, it has received funding from the European Union's Seventh Framework Programme.

With the support of





What is the Fibonacci Project ?

European authorities and the international scientific community acknowledge the major importance of Inquiry-Based Science and Mathematics Education (IBSME) for developing an integrated strategy for scientific literacy and awareness from primary to secondary school, raising interest in science and mathematics and reinforcing scientific careers. The FP6 projects Scienceduc and Pollen (www.pollen-europa.net) have already successfully implemented IBSE in 17 European cities. National programmes like the German SINUS-Transfer (<http://sinus-transfer.eu>) and the Austrian IMST (<http://imst.ac.at>) have reached a large number of schools all over their country and have supported the implementation of new aspects of mathematics and science teaching into curricula, teacher education and classroom teaching. These projects, along with others, have paved the way for a broader dissemination of IBSME methods and objectives.



The ambition of the Fibonacci Project is to contribute to the dissemination of such approaches throughout the European Union, in ways that fit with national or local specificities.

It defines a process of dissemination from 12 Reference Centres to 25 Twin Centres, based on quality and a global approach. This is done through the pairing of Reference Centres selected for their extensive school coverage and capacities for transfer of IBSME with 12 Twin Centres 1 and 13 Twin Centres 2, considered as Reference Centres-in-progress.

A scientific committee of acknowledged experts in science and mathematics education supervises the work. An external evaluation is also included to check the achievement and impact of the project.

The Fibonacci Project will result in a blueprint for a transfer methodology valid for building further Reference Centres in Europe.

The project, started on January 1, 2010 for a duration of 3 years, is coordinated by the French *La main à la pâte* programme (*Académie des sciences, Institut National de Recherche Pédagogique, École normale supérieure* – the latter being the legal entity in charge of Fibonacci); scientific coordination is shared with Bayreuth University (Germany).

The Consortium includes 25 members from 21 countries with endorsement from major scientific institutions such as Academies of Sciences. It will be subsidised up to 4.78 million euros by the European Commission 7th Framework Programme.



Three Pillars and Nine Basic Patterns as Core Structuring Elements

Pillar I. Inquiry-based science

and mathematics education for scientific literacy

IBSME goes beyond the learning of concepts and basic manipulation to the key factor of engaging students in identifying relevant evidence and reflecting on its interpretations. Through IBSME:

- ▶ students develop concepts that enable them to understand the scientific aspects of the world around them through their own thinking, using critical and logical reasoning about evidence that they have gathered.
- ▶ teachers lead students to develop the skills necessary for inquiry and the understanding of science concepts through their own activity and reasoning.

Pillar II. Local initiative for innovation and sustainability

Local and regional initiatives are particularly appropriate to the reform of scientific education in Europe:

- ▶ the potential for innovation is strong because of the reduced scale, the greater concentration of actors, and better integration into local policies.
- ▶ capitalisation of resources from different actors inside and outside the formal education system is possible, progressively involving the whole local community in a joint effort.
- ▶ schemes and tools can be tested previous to their replication on a larger scale.

Pillar III. Twinning strategy for IBSME dissemination

Dissemination of innovation is neither top-down nor bottom-up, but rather a transfer of semi-formalised practices and experiences that have reached a satisfactory level of recognition, expertise and sustainability on a local scale. Consequently:

- ▶ special efforts must be made with regard to the application of successful strategies inspired by Reference Centres.
- ▶ twinning and peer-learning through visits, tutoring, sharing resources and strategy transfer are the key to a broad and successful dissemination.
- ▶ focussing both on the strategy for implementation and on the pedagogical content is important.

Basic Patterns of Fibonacci (BPF) are touchstones for achieving a change in teaching and learning through IBSME that will be used by Fibonacci partners. BPF include:

1. Developing a problem-based culture
2. Working in a scientific manner
3. Learning from mistakes
4. Securing basic knowledge
5. Cumulative learning
6. Experiencing subject boundaries and interdisciplinary approaches
7. Promoting the participation of girls and boys
8. Promoting student cooperation
9. Autonomous learning

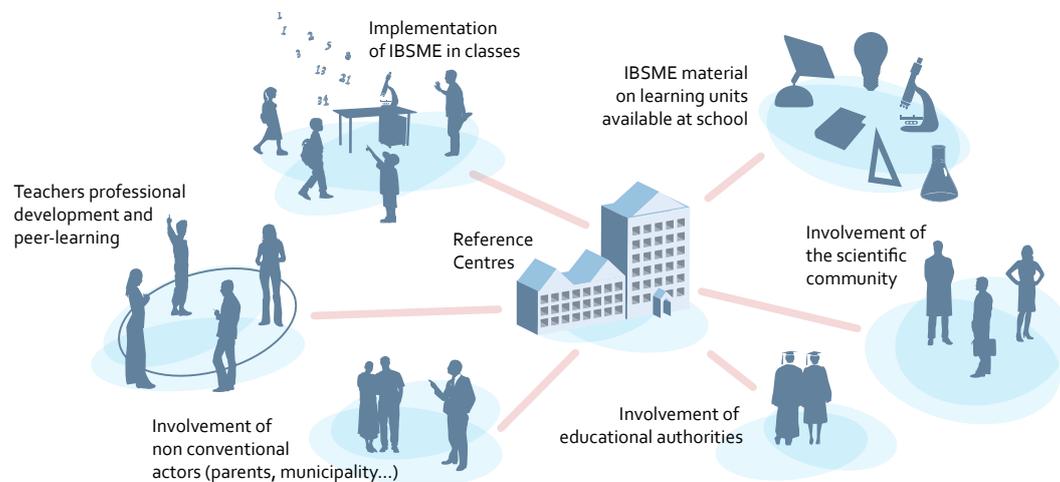


What is a Reference Centre ?

Our dissemination strategy is **based on a network of 12 Reference Centres** throughout Europe, all of which have a recognised expertise in the implementation of sustainable Inquiry-Based Science and/or Mathematics Education at local or national level.

Qualification of a Reference Centre:

Expertise in implementing an IBSME systemic approach at local level



Each Reference Centre basically relies on a local coordinator and a core team of experts and teacher educators. In Fibonacci, each Reference Centre will train and tutor two kinds of Twin Centres:

- ▶ Twin Centres 1 (TC1), which are members of the Fibonacci consortium and the first beneficiaries of the twinning.
- ▶ Twin Centres 2 (TC2), which have been identified at the beginning of the project and which will constitute a second dissemination ring.

Simultaneously, all centres (RC, TC1 and TC2) are in charge of developing IBSME in a significant number of classes (a minimum total of 660 each year) providing scientific material, professional development, follow-up and evaluation...

Twinning and tutoring cycle

In the first year, each Reference Centre organises a 4-day field visit, during one week, which is open to its Twin Centres 1 and 2. In the second year, Twin Centres 1 and 2 receive distance and face-to-face tutoring, advice and resources from the Reference Centre, in order to develop their own local project. In the third year, a second stage of field visits is organised for new players (TC3), who wish to know more about IBSME in regional initiatives.



Common activities and Dissemination

Twinning and Tutoring

Three levels of Twin Centres have been identified in the project, according to their expertise in IBSME. Apart from TC1 and TC2, 24 TC3 will become associated during the last year of the project, leading to a total of 60 institutions being involved throughout Europe, for a total of about 3000 teachers and 50000 pupils involved.

Common work among partners is organised through 5 major topics:

1. Deepening the specificities of inquiry in mathematics (coord: Bayreuth University)
2. Deepening the specificities of inquiry in natural sciences (coord: *La main à la pâte*)
3. Implementing and expanding a Reference Centre (coord: Free University Berlin)
4. Integrating inquiry across curricula (coord: University of Leicester)
5. Using the external environment of the school (coord: University of Helsinki)

Each topic group will organise European workshops and training sessions and produce a booklet of guidelines in order to structure a common approach at European level on each topic.

Conferences and public events

Two European conferences, open to outside participants, are scheduled within the framework of the project:

- ▶ **Raising awareness about IBSME in new countries** – Bayreuth, Germany (Sept 21–22, 2010). This starter conference particularly aims at raising a broad awareness around the project objectives.
- ▶ **Bridging the gap between scientific education research and practice** - Leicester, UK (April 26-27, 2012). This conference will bring together researchers and practitioners in scientific education.

A European collaborative project for teachers and classes

www.greenwave-europe.eu (opening winter 2010-2011)



Based on the platform and pedagogical project developed by Discover Science and Engineering/Discover Primary Science (Ireland), the Greenwave project deals with the fact that every year a green wave can be seen moving across Europe in springtime, as different species bud and come into leaf. Classes involved in the Fibonacci Project are invited to post on the website the species they spot which act as very early indicators of the arrival of spring and as nature's clock.

Evaluation of the dissemination process

All of these activities will be assessed by an external evaluator: Educonsult, Belgium. Educonsult is responsible for formative evaluation during the lifetime of the project and for a summative evaluation of the achievements. This evaluation will describe the concrete results and the impact of the project on the different actors, partners and structures, as well as their sustainability.

Fibonacci Project

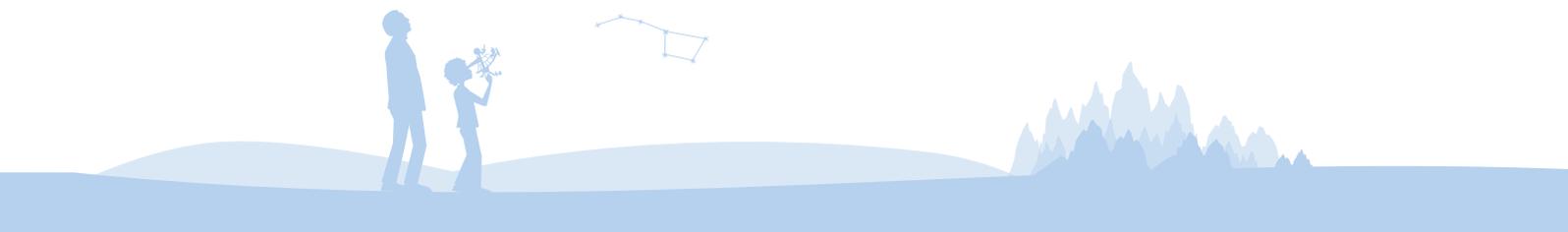
map & list of coordinators

European coordination & Scientific coordination for science	Scientific coordination for mathematics	Other members of the Scientific committee
France  La main à la pâte (French Academy of Sciences, École Normale Supérieure Lyon, École Normale Supérieure Paris) JASMIN David - david.jasmin@fondation-lamap.org	Germany  University of Bayreuth BAPTIST Peter peter.baptist@uni-bayreuth.de	UK - University of Bristol - HARLEN Wynne France - French Academy of Sciences - LENA Pierre UK - King's College, London - DILLON Justin France - Paris 7 University - ARTIGUE Michèle
Reference centres	Twin centres 1	Twin centres 2
Austria  University of Klagenfurt KRAINER Konrad Konrad.Krainer@uni-klu.ac.at	Finland  University of Helsinki SALMI Hannu hannu.Salmi@helsinki.fi	UK/ Scotland  University of Glasgow HAYWARD Louise l.hayward@educ.gla.ac.uk
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Reference centres	Twin centres 1	Twin centres 2
Netherlands 🇳🇱 University of Amsterdam - up to February 2011 VAN DEN BERG Ed e.vandenbergh@uva.nl	Romania 🇷🇴 National Institute for Lasers, Plasma and Radiation SPOREA Dan dan.sporea@inflpr.ro	Belgium (Flanders) 🇧🇪 Dienst Katholiek Onderwijs PEETERS Wim wim.peeters.int@telenet.be
Netherlands 🇳🇱 Hogeschool of Amsterdam - from March 2011 VAN DEN BERG Ed e.van.den.berg@hva.nl	Romania 🇷🇴 National Institute for Lasers, Plasma and Radiation SPOREA Dan dan.sporea@inflpr.ro	Austria 🇦🇹 Pädagogische Hochschule Wien BERTSCH Christian christian.bertsch@phwien.ac.at
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Associated partner for the Greenwave project:		External evaluator
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Resources

2010

A **Starting package** offers advice, learning units and guidelines to support a consistent implementation of the project. It includes the *Scientific background* of the project as well as the *Basic Patterns of Fibonacci*.

The Fibonacci website



www.fibonacci-project.eu

The website provides information, resources and tools for the project. All documents are freely available in English in the *Resources* section. Some will also be available on the multilingual European platform for the science education community Scientix (<http://scientix.eu>).



2012

Some of the main outcomes of the project will be presented in two kinds of documents:

- ▶ **5 guidelines on the 5 major topics**



- ▶ **A feasibility study for the creation of a European centre**

This feasibility study, capitalising on the project results, will deliver recommendations to the European Commission and European stakeholders on the best way to set up a permanent European Centre for Science and Mathematics education, with the capacity to follow up and foster initiatives in all member countries.

All these documents are/will be freely available on the Fibonacci website, in the *Resources* section.



How to participate ?

If you or your institution are interested in knowing more about Fibonacci or get involved according to your interest, you can:

- ▶ contact the national coordinator in your country for information and exchanges.
- ▶ register on the Fibonacci website:
 - to receive newsletters and information.
 - to participate in the 2 European conferences.
 - to take part in one of the 5 European training sessions on the 5 common topics.
- ▶ ask to be included on the waiting list for Twin Centres 3 as a new stage of field visits will be organised for 24 new players in 2012.
- ▶ contact directly the European coordination of the project: contact@fibonacci-project.eu

consortium members



Credits

Graphic design:
www.lezard-graphique.net - 2010

Flags icons:
www.IconDrawer.com

Fibonacci Picture:
Stefano Bolognini



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PARTNERS

EUROPEAN COORDINATION

 **France** - *La main à la pâte* (French Academy of Sciences, École Normale Supérieure Lyon, École Normale Supérieure Paris). For the purpose of the project, the Ecole Normale Supérieure of Paris is the legal entity coordinating the project.

SCIENTIFIC COORDINATION

Science:  **France** – *La main à la pâte* Mathematics:  **Germany** – University of Bayreuth

REFERENCE CENTRES

 **Austria** – University of Klagenfurt  **Denmark** – University College South Denmark  **France** – ARMINES/ Graduate School of Engineering of St Etienne  **France** – Graduate School of Engineering of Nantes
 **Germany** – Free University of Berlin  **Germany** – University of Augsburg  **Germany** – University of Bayreuth
 **Netherlands** – University of Amsterdam; Hogeschool of Amsterdam  **Slovakia** – University of Trnava  **Slovenia** – University of Ljubljana  **Sweden** – Royal Swedish Academy of Sciences
 **United Kingdom** – University of Leicester

TWIN CENTRES 1

 **Belgium** – Free University of Brussels  **Bulgaria** – Institute of mathematics and informatics of the Bulgarian Academy of Sciences  **Estonia** – University of Tartu  **Finland** – University of Helsinki
 **Greece** – University of Patras  **Ireland** – St Patrick's College  **Portugal** – Ciencia Viva, National Agency for Scientific and Technological Culture  **Czech Republic** – University of South Bohemia  **Luxembourg** – University of Luxembourg  **Romania** – National Institute for Lasers, Plasma and Radiation  **Serbia** – Vinca Institute for Nuclear Sciences  **Spain** – University of Cantabria  **Switzerland** – University of Zürich.

ASSOCIATED PARTNER FOR THE GREENWAVE PROJECT

 **Ireland** – Discover Science and Engineering - Discover Primary Science.

TWIN CENTRES 2

 **Austria** – Pädagogische Hochschule Wien  **Belgium** – Dienst Katholiek Onderwijs
 **Denmark** – NAVIMAT; Aarhus University  **Denmark** – VIA University College  **France** – PRES de l'Université de Lorraine  **Germany** – Cologne & Bonn Chambers of Commerce and Industry
 **Germany** – Thüringer Institut für Lehrerfortbildung  **Italy** – National Association of Science Teachers  **Poland** – Jagiellonian University  **Spain** – University of Alicante  **Turkey** – Academy of Sciences/TUBA  **UK/Scotland** – University of Glasgow  **UK / Northern Ireland** – Queen's University Belfast.

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