

**Grant Agreement Number 612367**



Including Responsible Research and Innovation in Cutting-Edge Science and  
Inquiry-Based Science Education to Improve Teacher's Ability of  
Bridging Learning Environments

## **D2.1 Strategies:**

Strategies for Constructing Communities of Learners (CoL)  
in the Different Countries

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**Table of Contents**

<b>1. Executive Summary</b> .....	3
<b>2. Report on the Strategies Per Country</b> .....	4
2.1 The Netherlands.....	5
2.2 Israel.....	9
2.3 Germany.....	11
2.4 Turkey.....	14
2.5 Portugal.....	16
2.6 Italy.....	19
2.7 Finland.....	22
2.8 Greece.....	24
2.9 Poland.....	27
2.10 Romania.....	30
2.11 Ireland.....	34
<b>3. Conclusion</b> .....	37

## 1. Executive Summary

A significant aspect of the IRRESISTIBLE project is that it will use Communities of Learners (CoL) in ten countries as the main method to develop the professional development of teachers. According to this approach, within the Communities of Learners, each group of members has a different role: teachers have expertise with working in the classroom; science educators bring their theoretical backgrounds about education; science centres have experience in informal learning activities; researchers are experts in cutting edge science research; and people from industry bring a perspective of the commercial and industrial applications of science. Each CoL includes experts from the field of formal and informal education, both in research and practice.

In order to implement this approach, at the first meeting of the IRRESISTIBLE project, which took place in Groningen in November of 2013, representatives from each country participated in a workshop on Communities of Learners – their characteristics, the theories behind them and how to build them. In this workshop, the representatives of each country were challenged to begin to design their own CoL. Based on this workshop, summaries for each CoL were prepared, which were developed in more detail after the meeting. The results of this work are presented in this document.

What we have found is that in each country, the educational context differs, so that different strategies need to be applied for constructing each country's CoL. The scientific topics are cutting-edge research taking place in the local universities, and are supported by the researchers that are part of the CoL. Cutting-edge scientific and technological topics highlight “frontiers science”, that is, science that is controversial, preliminary, uncertain and under debate. The controversial dimension refers to “differences over the nature and content of the science such as the perception of risk, interpretation of empirical data and scientific theories, as well as the social impact of science and technology” (Levinson, 2003, p. 1202). In the IRRESISTIBLE project, this controversial dimension is called the Responsible Research & Innovation (RRI) aspect, and it will be addressed in each CoL in an IBSE approach, according to the 6E model.

The D2.1 report describes the characterization of the CoL in each country and provides the following information: (a) *background information*: (1) the country, (2) the partners in the country, (3) the main scientific topic and (4) students' grade level; (b) *CoL creation and development*: (5) Potential CoL partners, (6) The context of the CoL meeting; (c) *Information regarding the CoL meetings*: (7) Date of the first meeting, (8) Date when the module will be completed, (9) meeting length and location, (10) number of meetings, (11) content and sequence of the meetings, (12) use of digital technology, and other comments.

## **2. Report on the Strategies by Country**

In this section we present a description of the strategies by country (goals, plans, methodology, etc.) for designing each of the 11 Communities of Learning in the IRRESISTIBLE project.

1. The Netherlands
2. Israel
3. Germany
4. Turkey
5. Portugal
6. Italy
7. Finland
8. Greece
9. Poland
10. Romania
11. Ireland

## 2.1 The Netherlands

<b>Background</b>	
1. Country	<b>Netherlands</b>
2. Institutions	University of Groningen Science LinX
3. Main topic	Healthy ageing
4. Grade level	10 <sup>th</sup> grade (general science and technology)
<b>CoL Creation and Development</b>	
5. Potential CoL partners:	5-10 teachers from different parts of the country, 1 or 2 university researchers (carbohydrate group), 1 informal learning expert, 1 formal learning expert
6. The context of the CoL meetings:	Network Noord is an activity organized by the University of Groningen in which science teachers in the region get together every month to work on their educational activities. The CoL can be part of that context, or we can make a separate context specific for this project.
<b>CoL Meetings</b>	
7. Date of first meeting	Most likely late August 2014
8. Date when module will be completed	We will try to be finished by January 2014.
9. Meeting length and location:	Biweekly meetings in a central place and virtually (Skype), duration about 2-3 hours
10. Number of meetings (2014):	Biweekly except for school holidays or every three weeks.
11. Content and sequence of the meetings (2014-5):	First two or three will focus on instruction/ learning workshops. After three we will start designing and

	working on lesson materials.
12. Use of digital technology	In the design of an interactive exhibit. digital technology will be used.  We will be using Blackboard ® for exchange purposes of the material. Teachers in the CoL will determine which other digital technology will be used.
<b>Other</b>	
13. Foreseeable challenges	Recruiting 25 teachers for the 2 <sup>nd</sup> round; funding
14. Other comments:	The module will include 12 lessons (6 weeks of class time)

There are quite a few subjects that need to be addressed:

Pedagogy:

- Learning model of Ausubel
- 5E plus method
- Moving from teacher oriented learning towards student oriented learning
- cooperative learning
- curricular alignment

Research:

- subject/ questions
- focus of the research groups
- links with the regular curriculum

Informal learning:

- background of design

Responsible Research and Innovation

- societal issues related to research
  - influence of society on research
  - impact on society of research

Principles in establishment and implementation of learning community:

- Getting to know each other
- Learning to trust each other
- Learning and building on each other strong points
- Develop responsibility for group product and
- Individual accountability
- Stimulate each other to high ambition levels
- Cooperative atmosphere

Phases in development and design of educational materials

Participants of the CoL will need to

- Agree about process
- Agree about content
- Reflection as base for development
- Cyclic development of material

A possible agenda for the CoL meetings could be:

### Meeting 1

Introduction of all participants

Introduction of the goal/ identification of the goal/ commitment to the goal

Introduction of relevant pedagogical knowledge through active learning

Teachers should put their knowledge in practice. Cooperative learning can only be learned by doing it in the classroom. Teachers need to be aware of cooperative learning methodology in order to design inquiry based learning, and to practice inquiry-based assignments.

### Meeting 2

Peer consultancy about time between now and previous meeting

Visit to the research lab, learning about the scientific content.

### Meeting 3

Peer consultancy about time between now and previous meeting

Visit to the science center, learning about the design of exhibits

Meeting 4

Peer consultancy about time between now and previous meeting

Brainstorm about educational material/ setting of tasks, learn about RRI

Meeting 5, 6, 7, 8

Peer consultancy about time between now and previous meeting

Feedback about material so far

Discussions/ decisions, material for piloting with students

Meeting 9

Peer consultancy about time between now and previous meeting

First version of draft of complete module

Try out of modules

Meeting 10

Peer consultancy about time between now and previous meeting

Meeting 11

Peer consultancy about time between now and previous meeting

Start development of final version of modules

Meeting 12

Presentation of final version of modules



## 2.2 ISRAEL

<b>Background</b>	
1. Country	<b>Israel</b>
2. Institutions	Weizmann Institute of Science The Clore Garden of Science
3. Main Topic:	Renewable energy sustainability (using nanoscience)
4. Grade Level	Middle to high school students
<b>CoL Creation and Development</b>	
5. Potential CoL partners	6 teachers, 1 scientist, 1 science museum staff member, 2 science educators
6. The context of the CoL meetings	The meetings are within the context of an academic science education course for teachers
<b>CoL Meetings</b>	
7. Date of first meeting	November 2013
8. Date when module will be completed	July 2014
9. Meeting length and location	4 hours per meeting at the Weizmann Institute
10. Number of meetings (2014)	13 meetings in 2013-4 and 13 meetings in 2014-5
11. Content and sequence of the meetings (2014-5).	What are the project's goals? What is a CoL? What is RRI? What is the scientific content? How to design a curriculum? How to design an interactive exhibit?

12. Use of digital technology	Use of a dedicated Facebook page for the CoL. Integrating ICT with the interactive exhibit.
<b>Other</b>	
13. Foreseeable challenges	Designing interactive exhibits dealing with nano and renewable energy

The CoL program of the Weizmann Institute team will deal with the following issues, in the following order:

1. Designing and forming the CoL (2 meetings)
2. Learning and understanding our chosen subject matter: renewable energy sustainability using nanoscience (3 meetings)
3. Learning and understanding the meaning of the 6E format for inquiry (1 meeting)
4. Learning and understanding the meaning of RRI (2 meetings)
5. Integrating our informal science education partner (The Garden of Science) into the CoL by learning the varieties of interactive exhibits and how to build them (2 meetings)
6. Integrating our school teachers into the CoL by considering how to integrate our module into formal school science program (1 meeting)
7. Designing our module (including the design of interactive exhibits) on the above subject matter (6 meetings)
8. Evaluating our module after trying it in school (3 meetings)
9. Reviewing the other modules in the project and deciding which module(s) to adopt in the 2nd round (1 meeting)

### 2.3 Germany

<b>Background</b>	
1. Country:	<b>Germany</b>
2. Institutions	IPN Deutsches Museum
3. Main Topic	Oceanography and climate change
4. Grade Level	10-12
<b>CoL Creation and Development</b>	
5. Potential CoL partners:	5+ Teachers, 1 educator, 2 museum people, 2 scientists
6. The context of the CoL meetings:	Application of in-service training program "transfer science → school", in connection with a lab for students and future teachers ("Kieler Forschungswerkstatt")
<b>CoL Meetings</b>	
7. Date of first meeting	May 2014 in Kiel, joint meeting with Kiel and Munich early autumn
8. Date when module will be completed	April 2015
9. Meeting length (hours):	Full team (real): 1 day Full team (virtual): 1h Local teams meetings: 3h
10. Number of meetings (2014):	Full team (real): 1 meeting in Kiel, one meeting in Munich. Full team (virtual): 3+ meetings Local teams meetings: 3 meetings at Kiel, 3 meetings at Munich
11. Content and sequence of the meetings (2014-5)	Content introduction, emphases of four areas of competence according

	to Science Standards, curriculum connections (traditional and new ideas), approaches for in-school and out-of-school learning, development of unit structure and material, testing, optimization
12. Use of digital technology	Video conferencing, collaborative working tools (Google Docs/Mahara/etc.)
<b>Other</b>	
13. Foreseeable challenges	Finding the right people for the CoL; Appropriate time frame; travel distance Kiel-Munich
14. Other comments	The plan involves participants from the north and the south.

The CoL program of IPN/ Deutsches Museum team will include the following issues, in the following order:

1. Prior to 1<sup>st</sup> meeting: sharing written information on topic (Oceanography and climate change), overview on existing material, general module structure, RRI, 6E
2. 1<sup>st</sup> full team meeting (Kiel): forming the group, basic discussions on topic, RRI, and the combination of both. Presentations by scientists and exhibits / activities of the student ocean lab at the Kieler Forschungswerkstatt
3. Work phase 1 with local team meetings at Kiel/Munich (+ virtual meeting(s)): developing rough module structure, deciding which topics to include and where to link them to the curricula.
4. 2<sup>nd</sup> full team meeting (Munich): sharing results from work phase 1, integrating the topic of exhibitions into the module (existing oceanography-exhibition at Deutsches Museum, student curated exhibitions). Defining the more detailed module structure.
5. Work phase 2 with local team meetings at Kiel/Munich (+ virtual meeting(s)): Specifying the module content, developing material ... → making module “ready to use”.

6. Piloting the module at school and evaluating it.
7. Final full team virtual meeting: Discussing the results of pilot, adapting where necessary, finalizing the module.

## 2.4 Turkey

<b>Background</b>	
1. Country:	<b>Turkey</b>
2. Institutions	Bogazici University Turkey Science Centres Foundation
3. Main Topic	Nano materials in life science
4. Grade Level:	Middle and High School
<b>CoL Creation and Development</b>	
5. Potential CoL partners:	9 teachers (1 biology + 3 chemistry + 3 physics + 2 middle school science), 1 scientist, 2 science educators, 1 science museum representative.
6. The context of the CoL meetings:	Voluntary meetings (not in the context of a course or seminar)
<b>CoL Meetings</b>	
7. Date of first meeting	January 11 <sup>th</sup> , 2014 (introduction)
8. Date when module will be completed	We will try to be finished by September 2014
9. Meeting length and location:	2 hour meetings, at the university
10. Number of meetings (2014):	Every other week on Saturdays at 14:00-16:00 (about 12 meetings between February-June 2014)
11. Content and sequence of the meetings (2014-5):	Introduction of the project and the goals. What is IBSE? What is RRI? What is the scientific content? How to develop a module including scientific content & activities to use at Nano Clubs of schools? How to design an interactive exhibit? How to evaluate student products?
12. Use of digital technology	Use Google Groups for communication and Dropbox for

	sharing materials.
<b>Other</b>	
13. Foreseeable challenges	How to keep the teachers involved?

The CoL program of Bogazici University team will include the following issues, in the following order:

**February-June 2014** (12 meetings):

1. review of current Nanoscience Education (2 meetings)
2. learning and understanding our chosen subject matter: nano materials in life sciences (Biomedical applications of nanotechnology) (2 meetings)
3. learning and understanding the meaning of IBSE (1 meeting)
4. learning and understanding the meaning of RRI (1 meeting)
5. designing and developing of our module (including scientific content & activities and web 2.0 applications) to use at Nano Clubs of schools (4 meetings)
6. discussing possible exhibit ideas to integrate in the module (1 meeting)
7. reviewing and revising our module before starting to use at the schools (1 meeting)

**September 2014 – June 2015** (16 meetings):

1. **September – December 2014:** Implementation of module at each school, conducting modules at schools, how to overcome challenges (3 meetings)
2. guiding students on designing interactive exhibits at each school (3 meetings)

**January 2015:** 1<sup>st</sup> Round Exhibit at each school

3. evaluating interactive exhibit at each school (3 meetings)
4. evaluating our module after trying it in school (2 meetings)
5. designing 'Interactive Exhibit of the 1<sup>st</sup> Round' at the Science Center (2 meetings)

**February 2015:** 1<sup>st</sup> Round Exhibit at the Science Center

6. evaluating interactive exhibit at the Science Center (2 meetings)
7. reviewing the other modules in the project and deciding which module(s) to adopt in the 2nd round (1 meeting)

**2.5 PORTUGAL**

<b>Background</b>	
1. Country:	<b>Portugal</b>
2. Institutions	Universidade de Lisboa Pavilhão do Conhecimento
3. Main Topic:	Genomics and oceanography
4. Grade Level	From Primary School to Secondary School
<b>CoL Creation and Development</b>	
5. Potential CoL partners:	25 teachers, 2 scientists, 1 or 2 science museum staff members, 5 science educators.  We will build on the communities of practice we already have. All the teachers were or are involved in master and/or PhD courses under our supervision.
6. The context of the CoL meetings:	The first 50 hours of the CoL (25h for meetings at the Institute of Education + 25h for individual and group work both at home and at each teacher's classroom) will correspond to a credited science teachers' in-service training course (conferring 2 credit units). Portuguese teachers must obtain, at least, 1 credit unit each year.
<b>CoL Meetings</b>	
7. Date of first meeting	6 <sup>th</sup> of March, 2014
8. Date when module will be completed	We will try to have the first version of the module by the end of October 2014.



9. Meeting length and location	In general, 3 hours per meeting at the Institute of Education.
10. Number of meetings (2014)	12 meetings
11. Content and sequence of the meetings (2014-5).	<ol style="list-style-type: none"> <li>1. Project goals + CoL + RRI + 6E;</li> <li>2. How to design an interactive exhibit?</li> <li>3. First scientific content;</li> <li>4. Web 2.0 apps for the implementation of 6E and interactive exhibit;</li> <li>5. Second scientific content;</li> <li>6. Developing modules about the two contents;</li> <li>7. Implementing modules in the classrooms (including the design of interactive exhibits);</li> <li>8. Presenting, discussing and evaluating the modules produced by different groups;</li> <li>9. Selecting the most interesting aspects of the different presented modules in order to develop the two final modules.</li> </ol>
12. Use of digital technology	<p>Use of a dedicated Facebook page for the CoL.</p> <p>Use of a Moodle platform.</p> <p>Integrating Web 2.0 tools with the 6E approach and the interactive exhibit.</p>
<b>Other</b>	
13. Foreseeable challenges	The development of interactive exhibits by teachers and students. To help them during this phase the science educators will be available to give support in each classroom.
14. Other comments:	<p>Need to prepare guidebook on "How to Prepare Exhibits and Posters"</p> <p>Contest for schools (2<sup>nd</sup> round)</p> <p>Invite more than 5 teachers (i.e., plan for attrition by some teachers)</p>

The CoL program of the Institute of Education (University of Lisbon) will involve the following meetings' sequence:

1. An introduction to the project goals, CoL, RRI and 6E. We will build on the communities of practice we already have. All the teachers were or are involved in master and/or PhD courses under our supervision. So, we are used to working with each other and all of them have experience with Web 2.0 tools and IBSE – 1 meeting + on-line support through Moodle platform.
2. What is an interactive exhibit, and how to design one? This session will be coordinated by our partners from “Pavilhão do Conhecimento” – 1 meeting + on-line support through Moodle platform.
3. Learning and understanding the first scientific content (genomics) and the meaning of RRI in this area. This session will be coordinated by one of the partner scientists – 1 meeting + on-line support through Moodle platform.
4. Learning and understanding how to use Web 2.0 apps for the implementation of the 6E approach and the interactive exhibit – 1 meeting + on-line support through Moodle platform.
5. Learning and understanding the second scientific content (oceanography) and the meaning of RRI in this area. This session will be coordinated by the other scientist – 1 meeting + on-line support through Moodle platform.
6. Developing modules about the two contents – 4 meetings + on-line support through Moodle platform.
7. Classroom implementation of the modules (including the design of interactive exhibits). To help teachers and students during this phase the science educators will be available to give support in each classroom – several hours at schools.
8. Presenting, discussing and evaluating the modules produced by different groups – Moodle platform + 1 (4 hours) meeting.  
Selecting the most interesting aspects of the different implemented modules in order to develop the two final modules – 2 meetings.

## 2.6 Italy

<b>Background</b>	
1. Country	<b>Italy</b>
2. Institutions	University of Palermo University of Bologna Museum of Bari
3. Main topic	Nanoscience and Nanotechnology (the specific topic will be decided in consultation with all partners)
4. Grade level	High school students (grade 9-13)
<b>CoL Creation and Development</b>	
5. Potential CoL partners	<ul style="list-style-type: none"> <li>• 8 teachers (4 chemistry teachers and 4 physics)</li> <li>• 4 scientists (3 chemists and 1 physicist)</li> <li>• 1 science museum staff member</li> <li>• 4 science educators</li> </ul> <p>The CoL foresees two connected groups: one centered in Bologna and the other one in Palermo. Each of them involves 4 teachers (2 chemistry and 2 physics teachers).</p>
6. The context of the CoL meetings	<p>For the first round of the project the meetings will be voluntary (not in the context of an academic course or seminar) and will involve in-service teachers.</p> <p>In the second round, the teacher CoL will be likely placed within an academic program of teacher education and/or within a National Plan of professional development.</p>
<b>CoL Meetings</b>	
7. Date of first meeting	December 5 <sup>th</sup> 2014
8. Date when module will be completed	September 20 <sup>th</sup> 2014 (that is, by the beginning of the 2014-2015 school year)

9. Meeting length and location	2-3 hours per standard meeting, at the University of Bologna, for a sub-group and at the University of Palermo for the other sub-group. 1 day for the workshop at the Museum of Bali.
10. Number of meetings (2014)	13 meetings, 1 workshop, about 5 web-seminars with following discussions
11. Content and sequence of the meetings (2014-5)	What are the project's goals? What is a CoL? What is the scientific content? What is RRI? How to design a curriculum by using the 6E method? How to design an interactive exhibit? How to test and to evaluate a curriculum?
12. Use of digital technology	Use of a dedicated Facebook page for the CoL, Skype for meetings between the two sub-groups, and Integrating ICT with the interactive exhibit.  Dropbox or other ICT facilities to share materials and documents between the two sub-groups.
<b>Other</b>	
13. Foreseeable challenges	Integration of the various types of expertise in the CoL, which is new, particularly large, articulated and made of two sub-groups.  Sustainability of the work due to the lack of a formal context and to the extended involvement requested to the teachers.

Italy participates in the project as two sub-groups: Bologna and Palermo. The coordination between these two sub-groups will be done by: a) sharing the materials and the agenda for the meetings, b) using Skype connection during some meetings, c) organizing a meeting of the whole CoL at the workshop at the Museum of Bali, and, if possible, d) exchanging some CoL members.

Content and sequence of the meetings (2014-5) for each sub-group:

1. Designing and forming the CoL by introducing the IRRESISTIBLE project, its aims and the 6E method (3 meetings, December 2013- January 2014)

2. Selecting the specific topic of the module in the frame of Nanoscience and Nanotechnology, choice and analysis of the existing teaching materials, also in light of RRI criteria (2 meetings January – February 2014)
3. Integrating all the teachers and the informal science education partner (Museum of Bali) to enter the sense of the IRRESISTIBLE project, its aims, the 6E method and the RRI aspect (1 meeting March 2014)
4. Short web-seminars of scientists on the selected topic of the module and web discussions among the CoL members to analyze, share and appropriate the scientific content and its social and environmental implications (using the ICT facilities, March 2014)
5. Learning and understanding the meaning of RRI and how to integrate RRI into the specific topic of the module (1 meeting, April 2014)
6. Considering how to integrate the module into formal school science program (2 meetings or a workshop, April-May 2014)
7. Learning the varieties of interactive exhibits and how to build them (1 workshop at the Museum of Bali, June 2014)
8. Finalizing the design of the module including the design of interactive exhibits and indications of activities for dealing with RRI issues in class (2 meetings within September 2014)
9. Evaluating the module after trying it in school (2 meetings, within 2014)
10. Reviewing the other modules in the project and deciding which module(s) to adopt in the 2nd round (1 meeting, January 2015)

## 2.7 Finland

<b>Background</b>	
1. Country	<b>Finland</b>
2. Institutions	University of Jyväskylä (JYU) University of Helsinki (UH) Jyväskylä University Science Museum
3. Main topic	Climate change
4. Grade level	Primary School Grade (grade 6)
<b>CoL Creation and Development</b>	
5. Potential CoL partners	1 museum staff member, 1 climate scientist from the university, 4 science education experts, 20 student teachers
6. The context of the CoL meetings:	The meetings will be during an educational science course.
<b>CoL Meetings</b>	
7. Date of first meeting	1.9.2014
8. Date when module will be completed	31.3.2015
9. Meeting length (hours)	2 hrs.
10. Number of meetings (2014)	11 meetings
11. Content and sequence of the meetings (2014-5)	Autumn 2014 and spring 2015: Preparing the study project and teaching-learning module on climate change for the elementary school. Implementing the module in classroom and museum with pupils. (See the schedule below, after the template)
12. Use of digital technology	Video conferences to allow CoL members from Helsinki to participate.

	Use of social media for communication between student teachers and climate scientists.
<b>Other</b>	
13. Foreseeable challenges:	Finding teachers for Round 2
14. Other comments:	Can we combine Rounds 1 and 2? Plan to use student teachers

The CoL program of JYU and HU team will deal with the following issues, in the following order:

1. Designing and forming the CoL (1 meeting) in September 2014
2. Study project meeting: learning and understanding principles of our chosen subject matter (climate change) and its incorporation to the elementary school (2 meetings, teacher students will also learn the topic during their study project)
3. Study project meeting: learning and understanding the meaning of RRI (1 meetings)
4. Study project meeting: integrating Jyväskylä University Science Museum into the CoL by learning the varieties of interactive exhibits and how to build them (2 meetings)
5. Study project meeting: integrating our five (training) schools into the project, including discussion on pupils prior knowledge (2 meetings)
6. Designing our module (including the design of interactive exhibits) on the above subject matter (1 formal meeting + several informal meetings + students' independent work)
7. Evaluating our module after trying it in the museum (5 meetings, one per each group)
8. Reviewing the other modules in the project and deciding which module(s) to adopt in the 2nd round (1 meetings)

## 2.8 Greece

<b>Background</b>	
1. Country	<b>Greece</b>
2. Institutions	University of Crete Eugenides Foundation
3. Main Topic:	Nanoscience applications (size-dependent properties)
4. Grade Level	Primary and Secondary (grades 5/6 to 11/12)
<b>CoL Creation and Development</b>	
5. Potential CoL partners	6 science and mathematics education researchers, 2 science researchers, 3 science museum staff members, 8 teachers (with MSc or PhD)  The CoL will be constituted by two working teams: one located in Athens and one located in Crete.
6. The context of the CoL meetings	The CoL will be an in-service professional development course. All the members of the CoL will be asked to volunteer their time.
<b>CoL Meetings</b>	
7. Date of first meeting	December 2013 (Crete) – January 2014 (Athens)
8. Date when module will be completed	About November 2014
9. Meeting length (hours) and location	2-3 hours  Each two months (face-to-face meetings) at the University of Crete and Eugenides Foundation and every 15 days virtually (Skype)
10. Number of meetings (2014)	14 meetings and 1 workshop
11. Content and sequence of the meetings (2014-5).	- The scientific field of Nanoscience & Nanotechnology



	<ul style="list-style-type: none"> <li>- Research on teaching and learning nanotechnology</li> <li>- Inquiry Based Learning</li> <li>- RRI</li> <li>- Science Museums - Development of Exhibitions</li> <li>- Using Web 2.0 Application in science teaching</li> <li>- Examples of Teaching Modules on Nanotechnology</li> <li>- Development of the teaching module</li> <li>- Evaluation of the module after the implementation in schools</li> </ul>
12. Use of digital technology	<p>Official web-site of the project</p> <p>A Facebook page in Greek for the CoL</p> <p>Skype meetings</p> <p>Use of interactive web-based educational applications</p> <p>Dropbox to share documents</p>
<b>Other</b>	
13. Foreseeable challenges	<ol style="list-style-type: none"> <li>1. How to bring together the members of the CoL team, since it is composed of members living in an island (Crete) and in Athens.</li> <li>2. The development of the teaching module, which has to be adjusted for primary and secondary students.</li> </ol>

The CoL program of the University of Crete/Eugenides Foundation team will deal with the following issues in the following order:

- Designing and forming the CoL (3 meetings)
- Subject Matter Clarification (nanoscience applications: size-dependent properties) (1 meetings)
- Science Education research on Nanotechnology (1 meeting)
- Inquiry Based Learning: The 6E Model (1 meeting)
- Clarifying RRI (1 meeting)
- Informal Science Teaching: Science Museums - Development of Exhibitions (1 meeting)
- Using Web 2.0 Application in science teaching (1 meeting)
- Examples of Teaching Modules Design on Nanotechnology integrating RRI: One or two-day workshop
- Development of the teaching module based on IBSE and RRI aspects: (4 meetings)
- Evaluation of the module after the implementation in schools (2 meetings)
- Reviewing the other modules in the project and deciding which module(s) to adopt in the 2nd round (1 meeting)

## 2.9 Poland

<b>Background</b>	
1. Country:	<b>Poland</b>
2. Institutions	Jagiellonian University Jagiellonian University Museum Collegium Maius
3. Main Topic:	Nanotechnology (catalysis)
4. Grade Level:	Upper secondary students (age: 16-19)
<b>CoL Creation and Development</b>	
5. Potential CoL partners:	7-8 chemistry teachers, 3 chemistry researchers, 1 science museum staff member, 3 chemistry educators
6. The context of the CoL meetings:	A distinct context (project IRRESISTIBLE), a part of regular, wide cooperation between faculty and school teachers. The CoL will be a part of in-service training.
<b>CoL Meetings</b>	
9. Date of first meeting	April 2014 (without teachers)
10. Date when module will be completed	End of 2014
7. Meeting length (hours):	2-3 hours  Monthly meetings, at the university or science center  1 day for the workshop at the Museum
8. Number of meetings (2014):	8 meetings (with teachers), monthly except school holidays
9. Content and sequence of the meetings (2014-5):	a. Project goals + CoL + RRI + IBSE + 6E; Web2.0 b. Scientific content, connections to school curriculum

	<p>c. Approaches for in-school and out-of-school learning, How to design an interactive exhibit?</p> <p>d. Developing module</p> <p>e. Testing - implementing module in the classrooms,</p> <p>f. Presenting, discussing and evaluating the module and school exhibitions.</p>
10. Use of digital technology	Moodle® and Dropbox®, national project website and Skype
<b>Other</b>	
11. Foreseeable challenges	2 <sup>nd</sup> round requirement of 25 teachers, competencies of teachers- leaders of CoL, nanoscience is not part of school curriculum, lack of a formal context, industry involvement, and how to keep the teachers involved?
12. Other comments:	<p>We are going to prepare a “guidebook” for teachers: What is RRI?, cutting- edge science, formal and informal education, how to prepare exhibits and posters (with examples).</p> <p>We will invite more than 5 teachers (to anticipate possible attrition)</p>

### Content and sequence of the meetings

The CoL program of the Jagiellonian University Foundation team will deal with the following issues. The planned order is:

1. Designing and forming CoL: scientists, educators, museum staff (1 meeting)
2. Learning and understanding the meaning of IBSE, 6E (1 meeting)
3. Integrating teachers into CoL presentation of goals, rules, communication channels (1 meeting),
4. Learning and understanding:

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- a) What does RRI mean? , subject matter: nanotechnology; finding connections to school curriculum of scientific content, a discussion about RRI issues of/in the chosen topic (2 meetings, one in lab)
  - b) How to use Web 2.0 and Moodle platform? (1 meeting)
  - c) Various forms of interactive exhibits and how to design an interactive exhibit? (2 meeting, study visit in Science Center Copernicus in Warsaw, workshop in JU Museum Collegium Maius)
5. Designing and developing of module to implement in real-school practice (3 meeting) , taking into account environmental aspect of the topic – nanochemistry in catalysis and its social dimension
  6. Presenting, discussing and evaluating of module and exhibition at schools(2 meeting), also within a scope of RRI
  7. Developing the two most interesting modules adopt in the 2<sup>nd</sup> round (1 meeting)

## 2.10 Romania

<b>Background</b>	
1. Country	<b>Romania</b>
2. Institutions	Valahia University Targoviste Prahova Natural Science Museum and History Museum Targoviste
3. Main Topic	Solar energy and specific nanomaterials
4. Grade Level	Secondary Education (7 <sup>th</sup> -12 <sup>th</sup> graders), but also Primary Education
<b>CoL Creation and Development</b>	
5. Potential CoL partners	<ul style="list-style-type: none"> <li>- 5+1 teachers known from previous collaborations (5 - Secondary Education Science teachers; 1 - Primary Education teacher);</li> <li>- 3 education experts;</li> <li>- 2-3 Science experts;</li> <li>- 1 IT expert;</li> <li>- 2 Museum experts;</li> <li>- 1 Library expert;</li> <li>- 1 Industry expert.</li> </ul>
6. The context of the CoL meetings	<p>The CoL meetings are organized in the context of an educational programme / training course proposed by the Romanian project partners (University and museums), defined as methodological and pedagogical activities for teachers. The working sessions / activities will be held at:</p> <ul style="list-style-type: none"> <li>- University research laboratories;</li> <li>- Museum halls and thematic exhibitions;</li> <li>- County's Library thematic presentations and book / multimedia exhibitions;</li> <li>- School Science laboratories.</li> </ul>
<b>CoL Meetings</b>	
7. Date of first meeting	- 10 December 2013 (first attempt to

	reunite the CoL - it did not have 100% participation) / Designing and setting up the CoL (1 <sup>st</sup> Meeting); - 28 January 2014 (appeal to reunite the CoL); / Designing and setting up the CoL (2 <sup>nd</sup> Meeting)
8. Date when module will be completed	- Estimated June/July 2014
9. Meeting length and location	- 4 hours per meeting at Valahia University Targoviste (meetings will be held also in each partner's location: University, Museums, schools, Library)
10. Number of meetings (2014)	- 13 meetings in 2013-4 (it is planned also to organize 12 meetings in 2015)
11. Content and sequence of the meetings (2014).	<ul style="list-style-type: none"> <li>- Presenting and discussing the project goals, subjects related to: CoL, RRI and the 6E Model;</li> <li>- Analysis of the specific context of Science teaching and learning in Romanian schools and of the possibilities to implement activities focused on renewable energy and nanomaterials in formal / non-formal contexts;</li> <li>- Analysis of the central issues assumed through the project: concepts specific to Science education, scientific content (renewable (solar) energy, nanomaterials), exhibits and interactive exhibits, but also means by which those ones can be disseminated to students and used in formal or non-formal educational activities;</li> <li>- Developing training modules dedicated to Science teacher training and formal / non-formal activities focusing on the central issues mentioned above;</li> <li>- Implementation, evaluation and optimization of the formal / non-formal learning activities for students.</li> </ul>
12. Use of digital technology	Meetings will take into consideration

	the use of an on-line platform / video conferences. A part of presentations related to “nano” issues will involve ICT.
<b>Other</b>	
13. Foreseeable challenges	<p>1. Curricula do not deal with “nano” issues and contains just few references related to renewable energy.</p> <p>2. The actual teaching materials do not provide applications of “nano” issues.</p> <p>3. In general, the teachers do not make the connections between the scientific content and most of the practical applications of nanotechnology.</p>
14. Other	-

The CoL meetings organized by the Romanian project partners (Valahia University Targoviste, Prahova Natural Science Museum and History Museum Targoviste) will deal with the following issues, as the planned order was established:

1. Designing and setting up the CoL (2 meetings - the first one exploratory).
2. Presenting and discussing the project main objectives, goals, CoL, RRI and 6E Model (2 meetings).
3. Learning and understanding the chosen topics matter: renewable (solar) energy sustainability using nanoscience / nanotechnology (the content will start with what is the role of “nano” in our everyday life and what is the importance of renewable (solar) energy) (1 meeting).
4. How to design an exhibit / interactive exhibit and what is the importance of its use in the process of Science teaching and learning? (1 meeting).
5. Developing the specific topics for the Training Modules – proposed titles: Education for Science and through Science in formal and non-formal contexts; Nanomaterials and renewable (solar) energy in the actual Science education through the Responsible Research and Innovation Perspective – and designing the project activities which that be implemented in students’ formal and non-formal activities (5-6 meetings).



6. Implementation process of the activities in the classroom *or* into non-formal school Science program (estimated: September - October 2014) (not counted as *meeting*).
7. Evaluating our project activities after the implementation process, followed by the selection of the projects / activity sequences that will produce the desired effects (1 meeting).
8. Reviewing the project activities and deciding which projects can be adopted for the 2<sup>nd</sup> round (1 meeting).

## 2.11 Ireland

<b>Background</b>	
1. Country	<b>Ireland</b>
2. Institutions	Synthesis and Solid State Pharmaceutical Centre, University of Limerick
3. Main Topic	Pharmaceutical processing and manufacturing, Drug Synthesis (including responsibilities to the developing world and the environment)
4. Grade Level	Upper Primary (age range 9-12) (Science Hub @ Learning Hub Limerick)  Secondary (Transition Year: Age range 14-16), Irish Science Teachers Association (ISTA), National Centre for Excellence in Mathematics and Science Teaching and Learning (NCE-MSTL), Eureka, Professional Development Service for Teachers (PDST), Chemical Education Research Group(CERG))
<b>CoL Creation and Development</b>	
5. Potential CoL partners:	Teachers, Pre-service Science teachers, Industry leaders, Science education researchers, Informal science educators, Artists, SSPC Communications Officer (Yvonne Diggins)
6. The context of the CoL meetings	The CoL will be conducted in the context of an in-service voluntary course. There is an issue with teacher professional development in Ireland which is to do with the economic situation and the teachers unions. Therefore, it is impossible to have the

	CoL as a non-voluntary in-service.
<b>CoL Meetings</b>	
7. Date of first meeting	23/06/2014
8. Date when module will be completed	Aim to be completed by January 2015
9. Meeting length and location	Science Hub @ Learning Hub Limerick, National Centre for Excellence in Mathematics and Science Teaching and Learning (Univ. of Limerick), Eureka, Uni College Cork
10. Number of meetings (2014)	<p>Aim for monthly or bi-monthly meetings, depending on teachers schedules some of the work may be carried out over the summer months while on school holidays, 3 Skype meetings</p> <p>The meetings will take place at the university, science hub and virtually.</p> <p>The aim for 2014 is to have a week long programme for teachers involved in the CoL during their summer holidays (1 workshop). This will be voluntary. Other than this there will be 9 meetings in 2014.</p>
11. Content and sequence of the meetings (2014-5)	What are the project's goals? What is a CoL? What is RRI? What is the scientific content? How do we design a curriculum? How could we design an interactive exhibit?
12. Use of digital technology	Use of Facebook, Twitter, Adobe Connect, Moodle
<b>Other</b>	
13. Foreseeable challenges	Finding the time and money to run the whole project; 2 <sup>nd</sup> round (PDST, NCE-MSTL, ISTA), economic climate

	and teacher unions (voluntary nature), curricula does not deal with pharmaceutical issues explicitly, and contains few references about the chemical or pharmaceutical industry. It is envisioned that this will be overcome by utilizing the Irish Transition Year (curriculum-free year)
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Describe in 1-2 paragraphs Content and sequence of the meetings (2014-5).

The CoL programme at the SSPC, University of Limerick will deal with the following issues, in this order:

1. Forming the research team to work on the CoL (2 meetings)
2. Designing and forming the CoL (5 meetings)
2. Learning and understanding our chosen subject matter: pharmaceutical processing, manufacturing and synthesis. (4 meetings)
3. Learning and understanding the meaning of RRI (2 meetings)
4. Integrating our informal science education partner (The Hunt Museum/The Science Hub) into the CoL by learning the varieties of interactive exhibits and how to build them (2 meetings)
5. Integrating our school teachers into the CoL by considering how to integrate our module into formal school science program (1 meeting)
6. Designing our module (including the design of interactive exhibits) on the above subject matter (8 meetings)
7. Evaluating our module after trying it in school (3 meetings)
8. Reviewing the other modules in the project and deciding which module(s) to adopt in the 2nd round (1 meetings)

### **3. CONCLUSION**

With details provided in this report, all partners have considered the main aspects of the IRRESISTIBLE project (namely: RRI, IBSE, scientific research and the formal-informal connection) while designing the strategies for their national CoL. It can be seen that the partners have considered the project's theoretical framework as well as its practical aspects (e.g., the project schedule) and have designed the CoL to answer the needs of the project.

The CoL strategies in this report will provide the framework for future work in the IRRESISTIBLE project, and templates for evaluating the progress of each country's work regarding their CoL.