Report O3-A4
CEYS Training Guide and Scenarios of Use

Authors: *Esme Glauert, Jillian Trevethan – UCL Institute of Education*

Module Authors: *Fani Stylianidou, Dimitris Rossis - Ellinogermaniki Agogi, Greece*
Teresa Cremin, Tatjana Dragovic-Andersen, Jessica Baines-Holmes – Open University
Adelina Sporea, Dan Sporea - National Institute for Laser, Plasma and Radiation, Romania
Bea Merckx, Jozefien Schaffler – Artevelde University College

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Introduction

This Training Guide provides an introduction to the Training Modules produced as part of the *Creativity in Early Years Science Education* (CEYS) project. CEYS was an Erasmus+ funded partnership (involving five partners in Greece, Belgium, England and Romania) that aimed to develop a teacher development course and accompanying classroom materials, to be used in professional development to promote the use of creative, inquiry-based approaches to early years science.

The Training Guide includes:

1. The background to the CEYS Project
2. CEYS project aims and objectives
3. Building on the work of the Creative Little Scientists (CLS) project
4. Development of the Training Modules in the CEYS project
5. Common principles that informed the design of the Training Modules
6. An overview of the Training Modules and associated support materials
7. Advice on using the Training Modules
8. Suggestions about how the Training Modules might be adapted for different audiences and time frames.
9. Further information available on the CEYS website.

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1. Background to the CEYS Project

The following perspectives underpinned the rationale and design of the CEYS Project.

1.1 Importance of early years science education

There is increasing recognition of young children's capabilities and the importance of early years education in building on early experiences and promoting scientific knowledge, understanding, skills and dispositions.

The importance of starting the teaching of science during early childhood, both for a child's development and for science learning has been more and more acknowledged. Young children's concern to explore the world around them can be nurtured and exploited through early science education. Moreover, quality science learning experiences provide an important foundation for the development of key concepts, thinking, informed language and positive attitudes in science. Finally a growing body of research in early years science indicates that children's thinking is surprisingly sophisticated and provides helpful starting points for developing scientific reasoning: children show awareness of patterns in observations and causal reasoning, albeit constrained by their conceptual knowledge, the nature of the task, and their awareness of their own thinking (Duschl *et al.*, 2007)

1.2 Links between science education and creativity

Schools in Europe today would benefit considerably from acknowledging and fostering the links between science education and creativity.

Science intrinsically involves inquiry and invention, both triggered by curiosity, intuition, and imagination, all elements closely related to creativity. It is also widely accepted nowadays that effective science education is based on inquiry, which can lead to wonderment, and is fuelled by curiosity. Creativity has moved away from a traditional link with the arts to a focus on problem finding and problem solving. Motivation has an important role to play in creativity too.

In the teaching and learning of science, a more creative approach based on curiosity and inquiry would be beneficial, involving, for instance, opening up opportunities for children to raise questions, make decisions, and be able to take risks and unlock their creativity.

1.3 Importance of collaboration between teachers and teacher educators

There is on the whole consensus that any materials to be used by teachers should be designed in collaboration with them and with the involvement of all relevant stakeholders so they are relevant and have the maximum potential for impact. Collaboration between schools and higher education institutions has the potential not only to improve initial teacher education but also to contribute to school development and teachers' professional development.

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2. The CEYS Project aims and objectives

The CEYS project aimed to develop a professional development and innovation course curriculum addressed to teachers, school leaders and teacher educators to be used in European programmes of Initial Teacher Education and (science-specific) Continuous Professional Development to promote the use of creative approaches to science in preschool and the first years of primary education, in the frame of inquiry-based educational environments.

The CEYS Project had the following objectives:

- Propose concrete **training materials** that can be used in teacher education for early years and primary teachers in order to foster their use of creative and inquiry-based approaches in science teaching.
- **Involve teachers as co-designers** in the iterative phases of development of its interventions, sharing their ownership and thus facilitating their adoption.
- **Implement and validate a number of training activities at national and international levels** with the scope to improve early years and primary teachers' knowledge and skills.
- **Develop a systematic evaluation methodology** in order to identify the impact of the proposed training processes and materials in terms of both effectiveness and efficiency.

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3. Building on the work of the Creative Little Scientists project

The CEYS project built on the work of the EU FP7 funded research project *Creative Little Scientists* (CLS) (2011-2014). This was organised into several phases shown in figure 1 below.

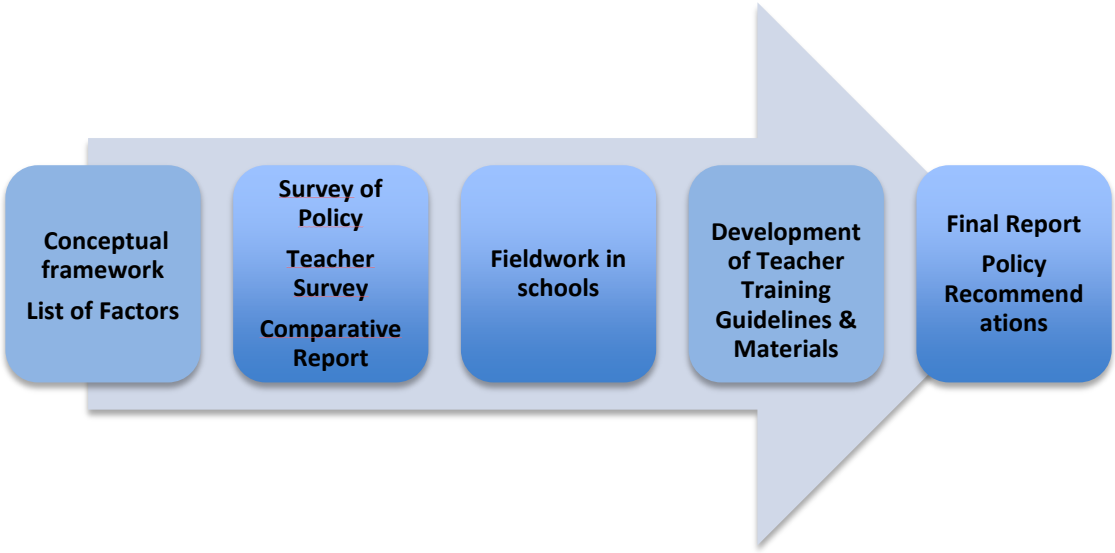

Figure 1: Key Phases in the Creative Little Scientists Project

Each phase produced publicly available reports (deliverables) that are available on the CLS website at http://www.creative-little-scientists.eu/content/deliverables. The Executive Summary of the Recommendations to Policy Makers and Stakeholders provides a useful overview of the CLS Project. Key contributions to the CEYS project are outlined below.

3.1 Conceptual Framework

3.1.1 Definition of creativity in early years science

The CEYS project drew on definitions of creativity and inquiry developed as part of the Conceptual Framework for the Creative Little Scientists project (CREATIVE LITTLE SCIENTISTS, 2012). Key features of inquiry-based approaches and dispositions associated with creativity identified are shown in table 1 below.

Learning activities (linked to key features of inquiry)	**Creative dispositions**
• Questioning • Designing and planning investigations • Gathering evidence • Making connections • Explaining evidence • Communicating explanations (for example Minner et al, 2010)	• Sense of initiative • Motivation • Ability to come up with something new • Making connections • Imagination • Curiosity • Ability to work together • Thinking skills (for example Chappell et al., 2008)

Table 1: Features of inquiry and creative dispositions

The CLS definition of creativity in early science and mathematics adopted by the CEYS project is: ***Generating ideas and strategies as an individual or community, reasoning critically between these and producing plausible explanations and strategies consistent***

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with the available evidence. This needs to be understood alongside the 'Little c creativity' definition (Craft, 2001), as shown in figure 2 below. This signals a focus on creativity as something of which we are all capable (Banaji and Burn, 2010) and recognition of key roles of creativity in both generating and evaluating ideas and strategies in science and mathematics education. The importance of generation and evaluation of ideas *within a community* is also emphasised. This includes examination of ideas in the context of existing, widely accepted explanations and strategies.

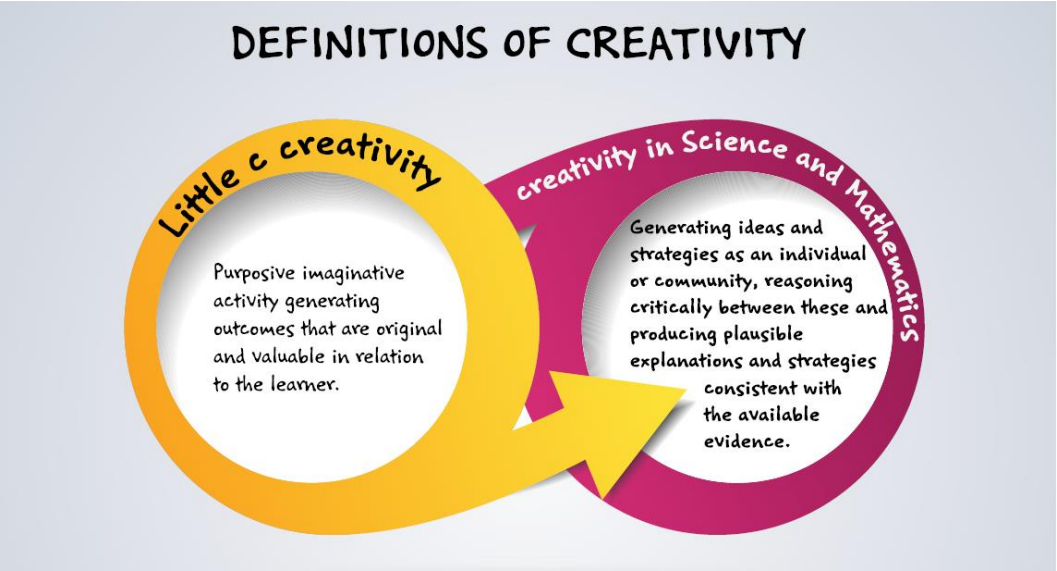

Figure 2: Definition of creativity in early years science

3.1.2 Synergies between Inquiry-based and creative approaches to learning and teaching

The CLS Conceptual Framework also identified a number of synergies between Inquiry Based Science Education and Creative Approaches as outlined below. These provided a framework for examination of opportunities for creativity and inquiry in both policy and practice.

- *Play and exploration*, recognising that playful experimentation / exploration is inherent in all young children's activity.
- *Motivation and affect*, highlighting the role of aesthetic engagement in promoting children's affective and emotional responses to science and mathematics activities.
- *Dialogue and collaboration*, accepting that dialogic engagement is inherent in everyday creativity in the classroom, enabling children to externalise, share and develop thinking.
- *Problem solving and agency*, recognising that through scaffolding the learning environment children can be provided with shared, meaningful, physical experiences and opportunities to develop their own questions as well as ideas about scientifically relevant concepts.
- *Questioning and curiosity,* recognising that creative teachers often employ open ended questions, and promote speculation by modelling their own curiosity.
- *Reflection and reasoning*, emphasising importance of metacognitive processes, reflective awareness and deliberate control of cognitive activities, still developing in young children but incorporated into early years science and mathematics practice.
- *Teacher scaffolding and involvement*, teachers mediating the learning to meet children's needs, rather than feeling pressurised to meet a given curriculum.
- *Assessment for learning,* identifying and building on the skills, attitudes, knowledge

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and understandings children bring to school; supporting and encouraging children's active engagement in learning and fostering their awareness of their own thinking and progress.

Further features of the CLS Conceptual Framework that were influential in developing Training Modules are outlined below. Further detail can be found in the references listed at the end of this document.

3.1.3 Curriculum dimensions (van den Akker, 2007, p39)

The CLS project identified three broad strands of significance in the opportunities provided for creativity in science – aims, teaching and learning, and assessment and contextual factors. These highlight the importance not only of learning and teaching processes in the classroom, but also of ways in which these are influenced by aims for science education, wider national and school contexts and teacher characteristics. These broad strands were examined in more detail using the framework of curriculum dimensions associated with 'the vulnerable spider web' from van den Akker (2007, p39) (shown in figure 3). These different dimensions that frame the curriculum are regarded as vulnerable because they are interconnected and what happens in one dimension affects another.

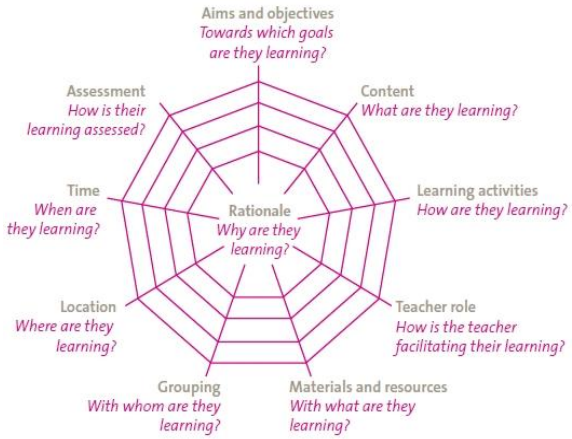

Figure 3: The Vulnerable Spider Web

3.1.4 Pedagogical Model (Siraj-Blatchford et al, 2002, p24)

In examining the dynamic interactions between the dimensions of the *vulnerable spider dimensions* in varied school and national contexts the *pedagogical model* used by Siraj-Blatchford et al (2002, p24) in the 'Researching Effective Pedagogy in the Early Years' project was helpful in distinguishing between teachers' face to face interactions, and their roles in pedagogical framing, related to wider aspects of the social and physical environment, and in examining the influence of the wider institutional context (shown in figure 4).

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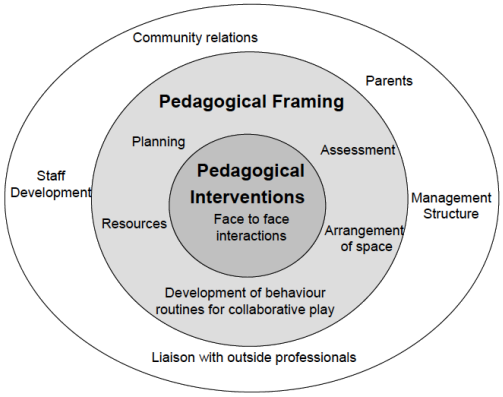

Figure 4: Pedagogical Model

3.1.5 Features of the Nature of Science (Akerson et al, 2011, p64)

Developing children's appreciation of the nature of science is widely highlighted as of key importance in promoting scientific literacy. Teachers have found this poster of key features of the nature of science supportive in thinking about the roles of inquiry and creativity in science and science learning, and aims of science education.

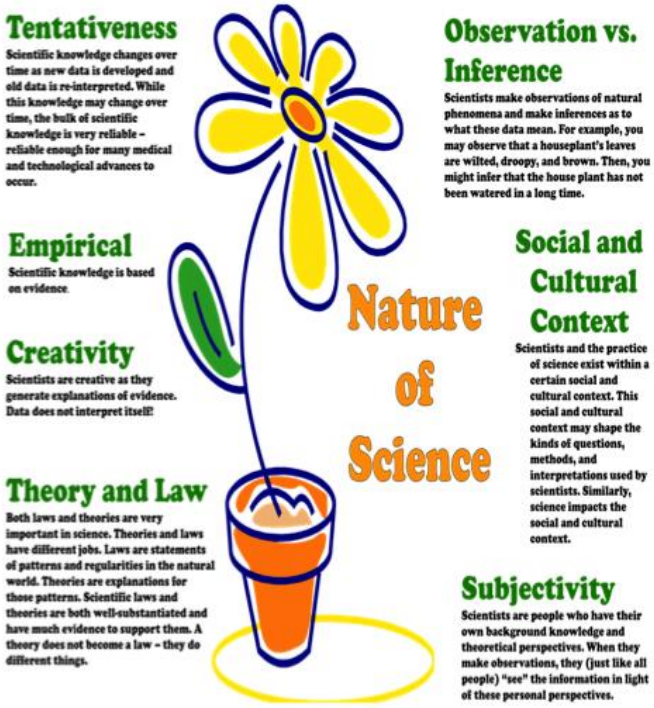

Figure 5: Features of the Nature of Science

3.1.6 Encouraging Creativity with Scientific Inquiry (Barrow, 2010, p3)

In the CLS Conceptual Framework, the model developed by Barrow is used to identify approaches in inquiry teaching and learning that can foster creativity. Barrow (2010) maps the five learner attributes of inquiry identified by the US National Research Council, to dimensions of student directedness or agency (shown in table 2). He considers how this scale reflects teacher approaches that range from student-directed open inquiry approaches, to guided inquiry approaches, and finally teacher directed structured approaches.

Essential features	Variations			
Learner engages in scientifically orientated questions	Learner poses a question	Learner selects among questions, poses new questions	Learner sharpens or clarifies question provided by teacher, materials or source	Learner engages in question provided by teacher, materials and source
Learner gives priority to evidence in responding to questions	Learner determines what constitutes evidence and collects it	Learner directed to collect certain data	Learner given data and asked to analyse	Learner given data and told how to analyse
Learner formulates explanations from evidence	Learner formulates explanations after summarising evidence	Learner guided in process of formulating explanations from evidence	Learner given possible ways to use evidence to formulate explanation	Learner provided with evidence
Learner connects explanations to scientific knowledge	Learner independently examines other resources and forms links to explanations	Learner directed toward areas and sources of scientific knowledge	Learner given possible connections	
Learner communicates and justifies explanations	Learner forms reasonable and logical argument to communicate explanations	Learner coached in development of communication	Learner provided broad guidelines to sharpen communication	Learner gives steps and procedures to communication
More.....Amount of Learner Self-Direction.....Less				
Less.....Amount of Direction from Teacher Material.....More				

Table 2: Essential features of classroom inquiry and their variations (Barrow, 2010: p3)

3.1.7 Perspectives on teacher education

Finally the CLS review of research in relation to teacher education identified a range of influential factors in teacher education that informed the development of CEYS training approaches, in particular:

- Teachers' beliefs, conceptions and attitudes towards science matter (e.g. Yilmaz-Tuzin, 2007).
- Successful teacher education programmes do not merely change, but build upon student teachers' beliefs (e.g. Schepens et al., 2009).
- Teaching portfolios, learning by doing, and partnerships between teacher educators and teachers have a positive impact on teachers' pedagogical knowledge and beliefs (e.g. Cochran-Smith & Zeichner, 2005).
- It is important to widen primary teachers' repertoire of teaching approaches to science (Newton and Newton, 2011).
- Multiple inquiry-based experiences, integrated into a science course help develop not only teachers' understanding of inquiry-based science instruction, but also an appreciation for the benefits of teaching and learning science in a constructivist environment (Varma, Volkmann, & Hanuscin, 2009).

3.2 Potential for creativity in policy and practice

The wide ranging research conducted into current policy and practice through a desk survey of policy and a survey of teachers' views and fieldwork in schools identified both the potential for creativity in policy and practice in partner countries and priority areas for development. The fieldwork in schools provided illustrative case studies of creativity in early years science that could be used in teacher education.

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3.3 Guidelines and Materials for Teacher Training

Findings from the first three phases of CLS research, combined with insights gained from online and face to face focus groups involving a wide range of stakeholders teachers, student teachers, school staff members, teacher educators, researchers were used to develop Guidelines and Materials for teacher education. The Guidelines set out Content Design Principles and Teacher Outcomes (shown in Appendix 1) to support the development of programmes of teacher education to foster creative, inquiry based approaches to early years science. The Exemplary Training Materials provide illustrations of ways in which classroom examples from the CLS project might be selected and used in teacher education. These provided a starting point for developing the First set of Training Modules developed in the CEYS project.

3.4 Recommendations for policy and teacher education

The Final Report and Policy Recommendations helped to frame priorities for attention in the development of the Training Modules produced by the CEYS project.

Specific details can be found in the following reports to be found on the CLS project website at http://www.creative-little-scientists.eu/content/deliverables.

D 2.2 Conceptual Framework
D 3.4 Comparative Report
D 4.4 Report of practices and their implications
D 5.2 Guidelines and Curricula for Teacher Training
D 5.3 Exemplary Teacher Training Materials
D 6.6 Recommendations to Policy Makers and Stakeholders on Creativity and Early Years Science: Executive Summary

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4. Development of the Training Modules in the CEYS project

The processes involved in the development of the Training Modules are shown in figure 6 below. They built on outcomes from the CLS project (as outlined above) and drew on advice and feedback from different stakeholders (including student teachers, teachers, senior managers, teacher educators, policy makers) at each stage in the process.

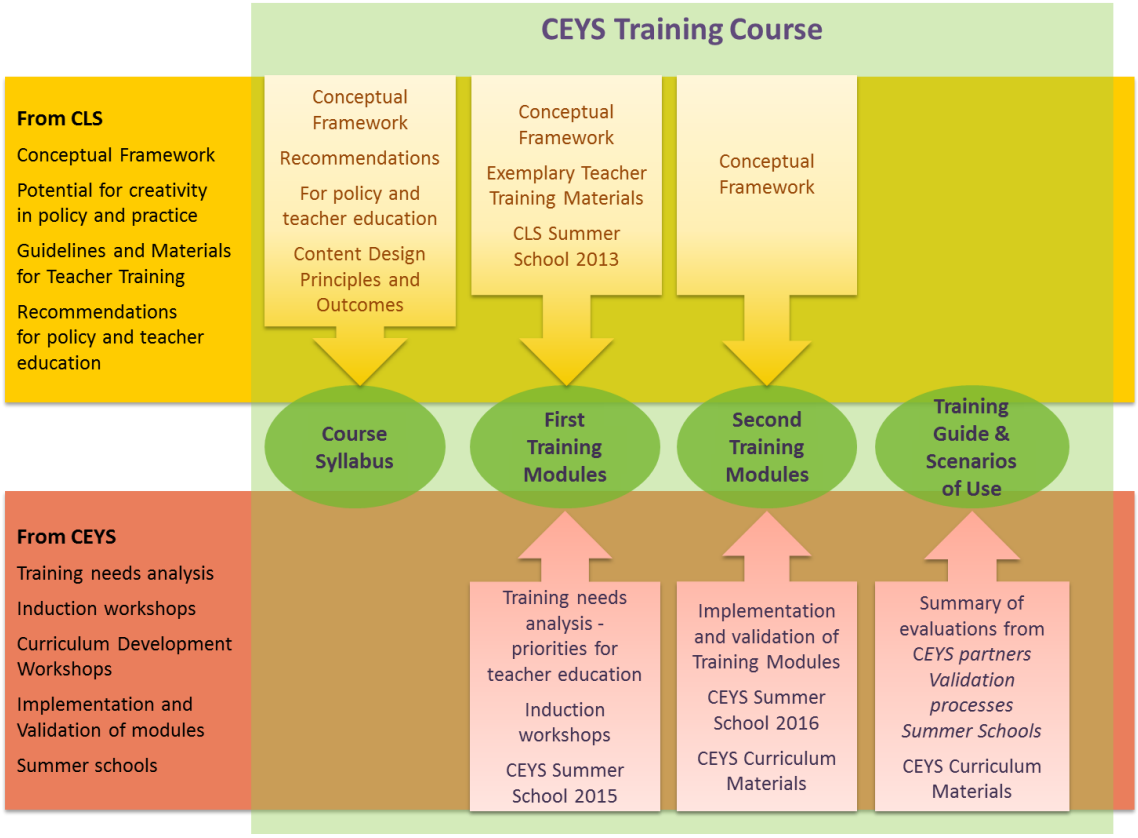

Figure 6: Development of the Training Course in the CEYS project

4.1 Development of the CEYS Course Syllabus

The Course Syllabus consists of 20 Training Modules as shown in table 3 below. The list is linked explicitly to the Conceptual Framework adopted by the CEYS project concerning synergies between creative and inquiry-based approaches to learning and teaching, features of creativity and the nature of science (shown in the left hand column). It is also designed to address the Content Design Principles and Teacher Outcomes proposed by the CLS project. The match of the 20 modules to the Content Design Principles and Outcomes is shown in Appendix 1.

The First 10 Training Modules provide an introduction to key characteristics of creative, inquiry-based approaches to early years science. The Second 10 Training Modules are designed to complement these, by considering in more detail how such approaches might be implemented within a programme of learning experiences over time. However the numbering of the modules within the first and second sets of Training Modules has no significance.

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Links to CLS Synergies, nature of science and creativity	First set of Training Modules (introducing key features of creative inquiry based approaches)	Second set of Training Modules (supporting issues of implementation within a programme of learning over time)
Play and exploration	7 Role of play and exploration in inquiry and creativity	20 Structured and unstructured play and exploration
Motivation and affect	2 Resources and the learning environment 10 Cross curricular project work	11 Linking learning in and outside school
Dialogue and collaboration	6 Collaboration and group work	
Problem solving and agency	4 Focus on inquiry-based science – link with creativity	
Questioning and curiosity	1 Using questions of teachers and children	
Reflection and reasoning	8 Varied modes of expression and representation	12 Reflection and reasoning 13 ICT to enhance inquiry
Teacher scaffolding	9 The role of the teacher	14 Planning for progression, building on children's ideas/questions 15 Interpreting policy – opening up opportunities for creativity
Assessment for learning		16 Assessment for learning – variety of strategies 17 Involving children in assessment, types of feedback
Nature of science	3 Focus on the nature of science	18 Nature of inquiry (different types of inquiry)
Nature of creativity	5 Focus on practical investigation which fosters creativity	19 Nature of creativity

Table 3: The CEYS Training Course

4.2 First Training Modules

The design of the First Training Modules drew on by materials and findings from the CLS project including

- Perspectives on approaches to teacher education
- Classroom episodes recorded through fieldwork in the CLS project.
- Suggestions included in the Exemplary Teacher Training Materials about how to use classroom episodes in training
- Priorities for development highlighted in the Recommendations for Policy and Teacher Education
- Evaluation of the teacher training programme developed for the CLS Summer School in 2013 that combined practical workshops for teachers with discussion of

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implications for classroom practice, facilitated by use of classroom episodes from the project.

The modules also took account of findings from the CEYS project training needs analysis and induction workshops and the CEYS Summer School 2015 conducted in the first year of the project concerning, priorities for teacher education, examples of effective and less effective teaching approaches and feedback on the trialling of teacher training approaches during the workshops.

The First Training Modules were then revised following trialling and evaluation by different partners in their national contexts, with different audiences and varied time frames, and were enriched by the inclusion of examples of Curriculum Materials developed by lead teachers through action research in the second year of the CEYS project.

4.3 Second Training modules

The Second Training Modules were able to draw on

- Lessons from the implementation and validation of the First Training Modules
- Curriculum Materials developed by 'lead' teachers through action research In the second year of the project
- Implementation and validation of the modules in varied contexts, with different audiences and varied time frames (including short workshops, half day and full day training events)
- Evaluation of the CEYS Summer School 2016 that took place in the second year of the project. This provided the opportunity to trial both the Training Modules and the use of Curriculum Materials in training and to design and evaluate the use of the Training Modules in a programme of training over several days.

4.4 Final Version of the CEYS Training Course

The summary of evaluations from teachers and CEYS partners across the two phases of implementation and validation of the modules and findings from the final CEYS Summer School in 2017 have informed the Final Version of the CEYS Training Course.

Specific details can be found in the following reports available on the CEYS website at http://www.ceys-project.eu/content/outcomes:

03 01 Development of Course Syllabus
03 02 Development of CEYS First Training Modules
03 03 Population of Course Modules
04 04 Report of Implementation and Validation of Training Activities.

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5. Design of the Training Modules

The processes associated with the development, implementation and validation of the Training Modules (as outlined above) informed the design of the Training Modules as shown below in relation to the Curriculum Design Dimensions associated with 'the vulnerable spider web' (shown in figure 3 above).

Rationale – The aims of the CEYS project (see p6) provided the central rationale for the development of the Training Modules. A more detailed rationale for each module is provided, linked to wider research in the field.

Aims & Objectives and Content – Each module is linked explicitly to the Content Design Principles and Teacher Outcomes (see Appendix 1). The programme of 20 modules is designed to ensure each of the principles and outcomes is addressed.

Learning activities – A range of learning activities is included in each module, employing experiences valued by participants and reflecting perspectives from research in teacher education for example:

- Building on current practices - recognising potential in everyday classroom activities
- Sharing experiences across schools/age phases
- Practical activities – viewing them from a child's perspective
- Analysis of classroom examples
- Time for reflection and self assessment
- Consideration of implications for future practice
- Discussion of adaptation/interpretation in local contexts.

Role of facilitator – The following roles for the facilitator are emphasized and inform the design of activities:

- Motivating and displaying enthusiasm
- Building confidence and relationships of trust
- Stimulating questions and reflection.

Materials and resources - The modules include use of everyday resources and materials accessible to teachers and familiar to children, and seek to provide and identify links to background teacher resources available online.

Grouping – The modules include opportunities for activities in small groups of varied composition, recognizing their value in involving participants and exchanging ideas for example through:

- Facilitating cross phase/school discussion
- Sharing experiences from varied national and international contexts
- Building opportunities for long term collaboration
- Recognising the value of discussion between teachers from the same setting in supporting classroom implementation and progression in children's learning.

Location – The modules include opportunities to participate in and reflect on learning in varied locations both indoors and out, formal and informal.

Time – The modules are designed to include time for brainstorming, discussion and questioning at different points during the session, alongside practical activity, to enable participants to explore, clarify and reflect on ideas. In trialling the modules participants indicated the importance of a sequence of training with ongoing opportunities for classroom implementation, review and further input. The Scenarios of Use below suggest how this

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might be achieved. They also provide examples of ways in which the modules can be adapted for different time frames.

Assessment – The modules recognize the central role of formative assessment in developing creative, inquiry-based approaches to learning and teaching. Explicit opportunities for assessment are included for example through

- Discussion of classroom examples from the CLS and CEYS projects, examining a variety of evidence of children's learning processes and progress, including their peer and self assessment and the role of the teacher
- Use of recording in varied ways (worksheets, posters, presentation) to support reflection processes
- Participants' discussion of their own views and practices and self-reflection on change and implications as a result of workshop activities.

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6. Module framework and Guidance

Each module follows a common template consisting of the following sections:

6.1 Module framework

- Aims of the module
- Links to CLS Curriculum Design Principles and Outcomes
- Rationale for the module – drawing on findings from wider research in the field – with an indication of key issues and challenges for teachers
- Overview of the module – this lists the programme of activities
- Module at a glance – this provides a suggested timetable of tasks, materials needed and groupings. This is generally based on a session of three hours to be adapted for different audiences and time frames.
- Teacher education pedagogy – explains the purpose of each activity and the rationale behind the teaching approaches suggested.
- Background reading – this offers suggestions for further background reading related to the module.
- Suggestions of classroom examples for discussion during the module
    - Classroom Episodes and/or Templates from the Creative Little Scientists project
    - Curriculum Materials recording teachers' learning journeys from the Creativity in Early Years Science project.

6.2 Module resources

List of resources provided for adaptation and use during the session (these are provided on the CEYS website in a folder as separate files) including:

- Powerpoint presentation corresponding to the activities outlined in the Module at a glance
- Suggested practical activities and list of resources for use during the session
- Recording sheets for use in relation to the different activities
- Handouts to support participants' analysis and reflection

An example of a module is shown below in Appendix 2. Further suggestions about how to use the materials and how they might be adapted for different audiences and contexts are provided in the sections that follow.

6.3 Selection and use of classroom examples

The Module Framework refers to three sources of classroom examples for discussion. In each case they make links to the CEYS Conceptual Framework. They include indications of the age group of the children and the country of origin. For each module, suitable examples for discussion are suggested, however you may wish to select alternative examples based on your audience and context.

Factors to consider in selecting classroom examples include:

- Links to the synergies relevant to the module. The Classroom Episodes, Templates and Curriculum Materials all indicate the particular synergies in focus, as shown below.
- Potential to address the Curriculum Design Principles and Outcomes associated with the module.
- The age group of the children.

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- Relevant contextual factors – needs of participants, local priorities and issues

Selected Classroom Episodes from the Creative Little Scientists project.

These can be found on the CLS website at www.creative-little-scientists.eu in the deliverable D4.4 Appendix Selected Episodes of Practice. Each Classroom Episode consists of two sheets of A4 as shown in figures 7a and 7b below.

The first sheet provides the background and description of the episode with an analysis of the potential for fostering creativity and inquiry in learning and teaching. The second sheet provides some examples of evidence such as photographs and comments made by children and teachers to illustrate the opportunities provided. If you are able, it is helpful to provide the episodes for participants to read in advance of the module. In discussing the episode during a session we have found it most productive to focus on the evidence on the second sheet and the issues and questions this raises.

creative little SCIENTISTS — Appendices of D4.4 Report on Practices and their Implications

Episode: UK(Sco) Forest School **Setting:** PreSch
Subject: Science **Age group** 3 -5 years old **Teacher:** Sarah
Key factors:
Learning activities: Gathering evidence (through observation) / Making connections
Pedagogy: Role of exploration /Fostering questioning and curiosity
Contextual factors: Recognition of outdoor learning / variety of resources

Aims
Visits to Forest School were planned to provide children with opportunities to explore the natural environment and observe change over time for example in the weather and in the life cycles of living things as highlighted in the interview with the teacher Sarah: *"seeing that place and being there in all weathers that's very important in schools – going to the same place and up the same road to get there – of course every time is different – they are affected by the weather, by the temperature, they notice that things that were here last week have been eaten or whatever that is."* Visits were also designed to encourage a range of inquiry skills in particular **observing** and **exploring, asking questions,** developing skills associated with reasoning and **making connections**.

Analysis of key features
The setting for the episode was a protected wildlife area in the city walking distance away from the preschool centre. It has open areas of vegetation, woodland and a pond. Children visit the site weekly, on an eight-week cycle. Activities and routines at the site have been developed over time, influenced by children's responses as well as incorporating common Forest School activities. These include making a shelter, litter picking, making a fire for cooking, climbing and balancing using ropes, as well as **observing changes** in the natural environment. Sarah indicated that the children often bring ideas and materials back to the centre, for example ideas for moving water or a hammock in the outdoor area and physical materials such as water samples from the pond or plant material, fostering on-going links between contexts.

On the day of the visit it was snowing. Centre staff, in partnership with parents, organise clothing and resources carefully to enable visits in all weathers. Mats, blankets, thermal clothing, warm drinks and snacks were taken to help children keep warm and comfortable. The outdoor trip, in harsh weather, offered the chance to encourage reflection on needs for survival, including warmth and shelter. A **variety of equipment** was packed to support activities at the site, including tarpaulin and ropes for making a shelter, magnifiers, binoculars and a camera to support observations, litter pickers and spades. Sarah was joined by two other adults on the visit, Marta and Gareth.

Conversations between adults and children on the way to the site focused on **observations** of the feeling of the wind and ice particles on their faces. Adults **asked questions** to encourage children to articulate their **observations** and to

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creative little SCIENTISTS — Appendices of D4.4 Report on Practices and their Implications

speculate on possible **explanations** for grit and salt on the paths. When they arrived at the site Sarah suggested various activities children might undertake including making a shelter, litter picking, climbing with ropes and observing ice on the pond. Children were encouraged to make their own decisions about what they would like to do.

This episode follows the **explorations** of Ian to illustrate the opportunities provided for children to **follow their own interests** and **make connections** to their previous experiences at the site. His immediate focus was the pond. He poked the ice with a spade. He **observed** holes in the ice and collected some water in his spade to look at it more closely. Sarah **built on his interest** drawing attention to the differences in the pond compared to the previous week and suggesting that he might look at the water more closely with a magnifier.

After some considerable time Ian was still at the pond. This time he was poking at the ice with a litter picker. Marta the Nursery Nurse asked him about what he was noticing, encouraging him to explain what he was doing. Ian explained that he had noticed bubbles. He thought that these might come from frogs and he was breaking up the ice *"so they* (the frogs) *can breathe"*.

Later Ian took the researcher round the site to photograph the different fungi he had noticed, another developing area of interest over time. In a conversation with the researcher about this visit to Forest School later in the afternoon, Ian highlighted these two activities (breaking ice and photographing fungi), **making connections** with previous experiences at Forest School. The photographs taken by Ian in collaboration with Sarah were included with Ian's reflections (**self assessment**) in his profile.

Opportunities for inquiry and creativity
The visit to Forest School offered rich opportunities for fostering creative dispositions including **motivation, curiosity and sense of initiative** reflected in Ian's active pursuit of his interests and observations. He showed **imagination and made connections** to his prior knowledge and experience in seeking to explain the bubbles he noticed in the pond and his actions in breaking the ice.

Features of creative teaching were reflected in the opportunities for learning in the **outdoor environment** made possible by careful organisation and preparation of **materials** to support **explorations** and ongoing assessment with children of the potential risks involved (for example in climbing or breaking the ice). Adult interactions fostered children's **own interests actively encouraging explorations, questioning** was used to encourage children to extend observations and **articulate explanations**.

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Figure 7a Selected Classroom Episode: Forest School Sheet 1

Erasmus+
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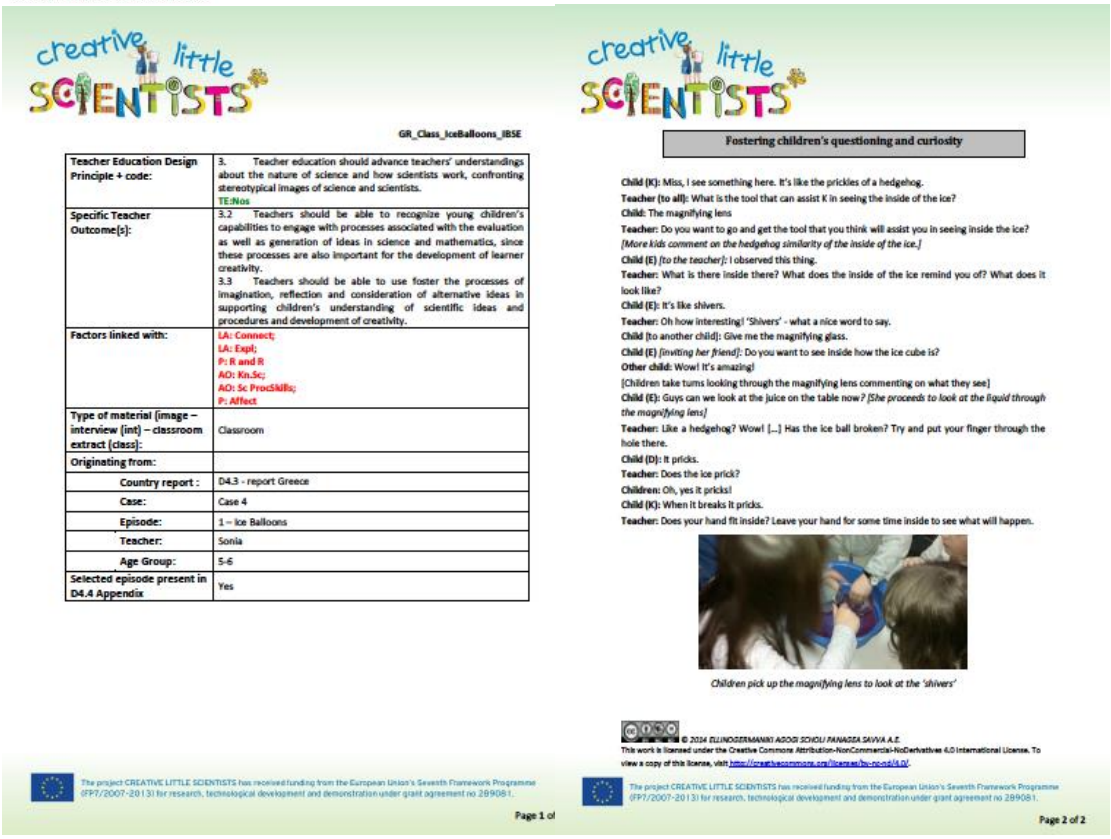
ΙΔΡΥΜΑ ΚΡΑΤΙΚΩΝ ΥΠΟΤΡΟΦΙΩΝ IKY

Figure 7b Selected Classroom Episode: Forest School Sheet 2

Templates of classroom examples from the Creative Little Scientists project

The templates can be found in the CLS deliverable Addendum to D5.3 Exemplary Teacher Training Materials on the CLS website. These are structured in an excel file that enables you to select examples related to the Curriculum Design Principles. They provide information about the origins and age group for the example. The templates include a description of the context with some extracts from the data collected, illustrative of the potential for creativity (see figure 8).



GR_Class_IceBalloons_IBSE

Teacher Education Design Principle + code:	3. Teacher education should advance teachers' understandings about the nature of science and how scientists work, confronting stereotypical images of science and scientists. TE:Nos
Specific Teacher Outcome(s):	3.2 Teachers should be able to recognize young children's capabilities to engage with processes associated with the evaluation as well as generation of ideas in science and mathematics, since these processes are also important for the development of learner creativity. 3.3 Teachers should be able to use foster the processes of imagination, reflection and consideration of alternative ideas in supporting children's understanding of scientific ideas and procedures and development of creativity.
Factors linked with:	LA: Connect; LA: Expl; P: R and R AO: Kn.Sc; AO: Sc ProcSkills; P: Affect
Type of material (image – interview (int) – classroom extract (class):	Classroom
Originating from:	
Country report :	D4.3 - report Greece
Case:	Case 4
Episode:	1 – Ice Balloons
Teacher:	Sonia
Age Group:	5-6
Selected episode present in D4.4 Appendix	Yes

Fostering children's questioning and curiosity

Child (K): Miss, I see something here. It's like the prickles of a hedgehog.
Teacher (to all): What is the tool that can assist K in seeing the inside of the ice?
Child: The magnifying lens
Teacher: Do you want to go and get the tool that you think will assist you in seeing inside the ice?
[More kids comment on the hedgehog similarity of the inside of the ice.]
Child (E) *[to the teacher]:* I observed this thing.
Teacher: What is there inside there? What does the inside of the ice remind you of? What does it look like?
Child (E): It's like shivers.
Teacher: Oh how interesting! 'Shivers' - what a nice word to say.
Child [to another child]: Give me the magnifying glass.
Child (E) *[inviting her friend]:* Do you want to see inside how the ice cube is?
Other child: Wow! It's amazing!
[Children take turns looking through the magnifying lens commenting on what they see]
Child (E): Guys can we look at the juice on the table now? *[She proceeds to look at the liquid through the magnifying lens]*
Teacher: Like a hedgehog? Wow! [...] Has the ice ball broken? Try and put your finger through the hole there.
Child (D): It pricks.
Teacher: Does the ice prick?
Children: Oh, yes it pricks!
Child (K): When it breaks it pricks.
Teacher: Does your hand fit inside? Leave your hand for some time inside to see what will happen.

Children pick up the magnifying lens to look at the 'shivers'

Figure 8: Classroom Template: Ice Balloons

In both cases it is helpful if you are familiar with the material and provide a brief introduction to the classroom context before discussion of the examples. You can find further background information related to the classroom extracts included in the episodes and templates in the relevant country reports of fieldwork found in the CLS deliverable D4.3 Country Reports. (The country codes are as follows: BE(Belgium), FI (Finland), FRA (France), GE (Germany), GR (Greece), MA (Malta), PT (Portugal), RO (Romania), UK (United Kingdom), EN (England), NI (Northern Ireland), SC (Scotland), WA (Wales)).

CEYS Curriculum Materials

The CEYS Curriculum Materials are longer documents available in both powerpoint and word versions on the CEYS website (www.ceys-project.eu). They record the learning journeys of teachers and children over time. They follow a common structure as follows:

- *Setting the scene* – providing details of the focus, rationale, background to the learning journey
- *Starting points* – how the project began and the sequence of learning activities
- *Developing the learning journey* – information about the activities and their rationale; examples of children's responses; teacher reflections and implications for the next session
- *Reflections* – children's progress, teacher role, classroom environment, next steps.

An example is shown in figure 9 below that illustrates some of the common elements included.

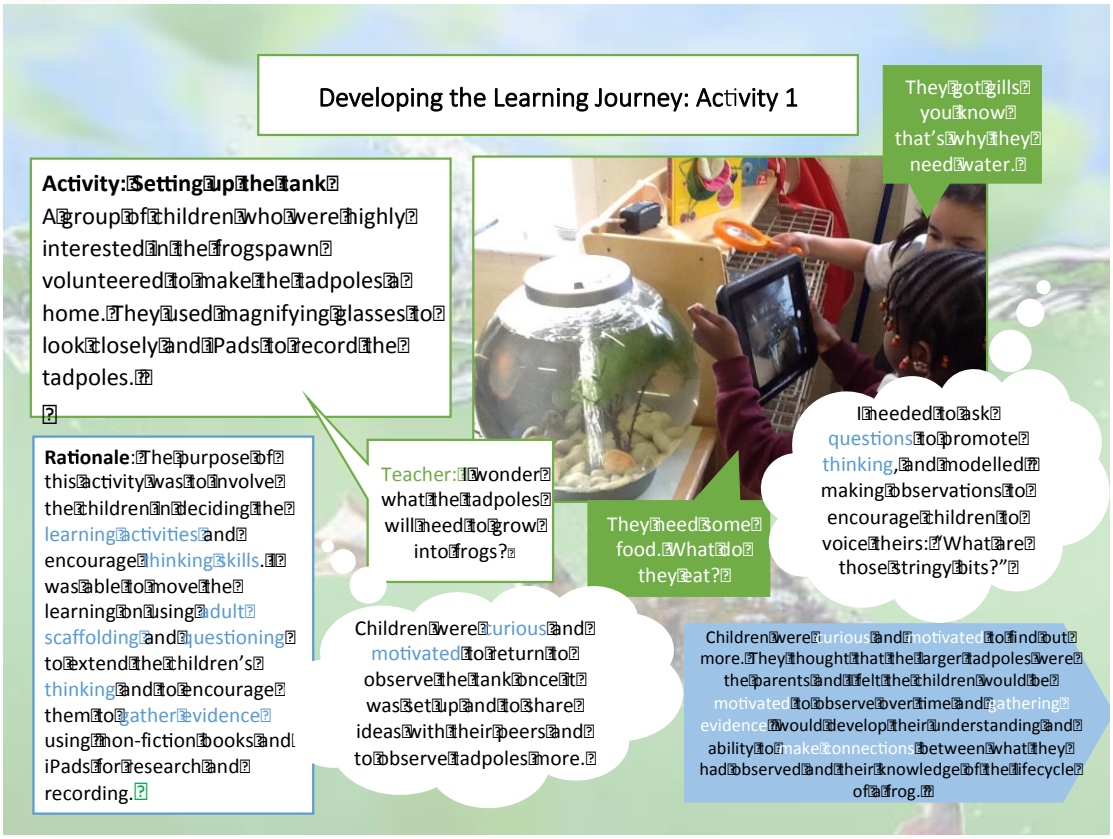


Figure 9: Extract from Learning Journey: The Life Cycle of a Frog

Further information can be found in the document 'Introduction to Curriculum Materials' found on the CEYS website. *Appendix 3* in the document suggests Curriculum Materials for use in each Training Module. We have found that a ***staged and guided approach*** is helpful in making the most of what the Curriculum Materials have to offer:

1. Gaining an overview of the learning journey – possible approaches include:

- Time to read through the materials first. They could be provided in advance of training sessions.
- Presentation by a facilitator – showing selected slides to provide the context.

2. Focused analysis, discussion and reflection related for example to:

- Issues and questions identified by the participants
- Focus of the teacher's learning journey – linked to the synergies
- Evidence of children's progress – related to inquiry skills, creative dispositions, science concepts
- Reflection questions for the reader

6.4 Selection of practical activities

The modules include suggestions of practical activities to include in the training, but many others would be possible drawing on local teaching and training materials. Key considerations in selecting suitable activities have included

- Offer opportunities for participants' creativity and inquiry
- Potential to be motivating for teachers as well as children
- Use of accessible resources
- Yield results in a limited period of time

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- Enable discussion of scientific processes and concepts
- Could be adapted for use with different age groups in varied classroom contexts

7. Scenarios of Use

In implementing and evaluating the Training Modules CEYS partners explored different scenarios of use involving different participants and time frames. While the modules provide a timetable and suggested activities for a three-hour training session, these can be modified to meet local needs and circumstances, in line with the principles that informed the design of the training modules. Some suggestions about the selection of modules for particular audiences and their adaptation for training for different durations are outlined below.

7.1 Introduction to the CEYS project

You may find it helpful to provide some background information to the CEYS project at the start of a training session. The CEYS brochure provides useful overview for participants. A powerpoint presentation is also provided for use as appropriate to introduce the project.

7.2 Selection of modules for particular audiences

The selection of modules for particular audiences will depend on details of their background, experience and training needs. In general terms, if participants are unfamiliar with the work of the CEYS project the First 10 Training Modules are most suitable as starting points. In particular Module 4: Focus on Inquiry-based Science – link with creativity provides a helpful introduction to creative, inquiry-based approaches to learning and teaching and the work of the CEYS project. Module 1: Using questions of teachers and children is also accessible for participants new to the project. If you are aware in advance of the particular needs of your participants you could use the list of modules alongside the Content Design Principles and Outcomes shown in Appendix 2 to inform your selection.

7.3 Development of a one-day programme

If you are running a one- day programme or a series of workshops there are a number of possible approaches. If you started with one of the First Training Modules you could select another from the First 10 for example:

- Focusing on a different feature of inquiry and creativity – such as questioning (Module 1), problem solving and agency (Module 4) or reflection and reasoning (Module 8)
- Exploring the nature of creativity (Module 5) or the nature of science (Module 3) in more detail
- Examining general features of classroom contexts that have the potential to promote inquiry and creativity such as Module 6: Collaboration and Group work, Module 7: Role of Play and Exploration, Module 9: The Role of the Teacher.

Alternatively you could deepen discussion through consideration of children's learning over time through selecting a module from the 10 Second Training Modules. These offer opportunities in particular for considering implications for planning and assessment for example:

- Linking learning in and outside the classroom - over time (Module 11)
- Planning for progression building on children's ideas and questions (Module 14)
- Involving children in assessment (Module 17)

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7.4 Planning a series of 2/3 training sessions over time

In addition to the considerations in designing a one-day programme, as outlined above, a series of training sessions over time offers valuable opportunities for participants to build on what they have gained from a module by exploring new approaches to teaching and learning in their classrooms in between sessions. They can be invited to bring examples of planning, teaching and assessment to the next training session for discussion of the opportunities and challenges associated with implementing creative, inquiry-based approaches in the classroom.

7.5 Development of a programme of several days

The programme from the CEYS Summer School in 2017 shown in table 4 below provides and example of a training programme of several days. It illustrates progression from an introduction to creative, inquiry-based approaches and the nature of science and creativity to issues of planning and assessment later in the programme. The programme provides opportunities for participants to review and deepen their understanding of the CEYS Conceptual Framework in a range of different contexts and develop detailed action plans for the implementation of creative, inquiry-based approaches in their classrooms. Participants kept a record of their ongoing reflections and implications for practice, updated following each module to inform action planning in the final session.

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
AM	Arrival	Module 4: Focus on inquiry-based science link with creativity	Module 11: Linking children's learning in and outside school	Module 3: Focus on the nature of science	Module 12: Reflection and reasoning	Module 15: Interpreting policy – linked to action planning
PM	Introduction to the CEYS Project Introduction to the Summer School	Module 19: Nature of creativity, examples of practice	Module 14: Planning for progression - building on children's ideas and questions	Educational visit	Module 17: Assessment for learning	Departure

Table 4: CEYS Summer School Programme 2017

7.6 Adapting a module for a short staff training session

Often staff training sessions in schools, or conference workshops, are of shorter duration than three hours. The training modules have the potential to be adapted for a more limited time frame. The experience of trialling and validation of the modules suggests that it is important to include a balance of the following module elements (with some reduction in time dedicated to formal written recording by participants and group feedback to make this possible).

- **Introduction** – for example including aims, rationale, brief activity to foster discussion of initial ideas and practices, introduction to relevant features of the CEYS conceptual framework
- **Practical activities** – drawing out characteristics and potential related to creativity and inquiry in learning and teaching

- **Discussion of classroom examples** – evidence of children's inquiry and creativity and the role of the teacher
- **Time for reflection** – discussion of implications and evaluation.

It is also helpful to provide participants with the CEYS brochure that gives an overview of the project and indicate links to reports and resources on the CEYS and CLS websites where they can gain further information and follow up on the content of the module. Suggestions for background reading are also included in the Framework for each training module.

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APPENDICES

Appendix 1: Module 4: Focus on Inquiry-based Science – link with creativity

Aims of the module

- Introduce participants to characteristics of inquiry-based approaches to science education
- Explore opportunities for creativity within scientific inquiry
- Examine connections between inquiry-based and creative approaches to learning and teaching
- Consider ways in which practitioners can promote children's decision making and creativity in science building on their own ideas and questions
- Enable participants to reflect on opportunities for fostering inquiry-based and creative approaches to science, within both policy and practice, in their own educational settings.

Links to the Curriculum Design Principles and Outcomes

6. Teacher education should provide pedagogical content knowledge to stimulate inquiry and problem solving in science and mathematics education.

6.2 Teachers should be able to open up everyday learning activities to allow greater opportunities for inquiry, problem solving and scope for creativity.

6.3 Teachers should be able to recognise the key roles of children's questioning and existing ideas (both implicit and explicit) of science and mathematics.

6.4 Teachers should be able to use a variety of strategies for eliciting and building on children's questions and ideas during inquiry processes (before, during and after explorations and investigations).

6.5 Teachers should be able to foster opportunities for children's agency and creativity in learning in inquiry and problem solving – in particular the importance of children making their own decisions during inquiry processes, making their own connections between questions, planning and evaluating evidence, and reflecting on outcomes.

Rationale for the module

What has led to the focus on Inquiry-based science?

In recent years there has been growing emphasis in policy on scientific literacy as an aim of science education. Scientific literacy was defined by the OECD as:

> The capacity to use scientific knowledge, to identify questions and draw evidence-based conclusions in order to understand and make decisions about the natural world and make changes to it through human activity. (Harlen, 2001)

This trend is reflected internationally through the inclusion of the development of scientific inquiry skills and understanding of scientific ways of working within curriculum requirements for science education.

There is widespread recognition of the central role of inquiry processes in young children's learning in fostering the skills and understandings and associated with scientific inquiry, alongside the development of scientific concepts.

For example as noted in the Conceptual Framework adopted by the CEYS Project (Creative Little Scientists, 2012: 32):

> Young children's experiences, both informal experiences and those nurtured in the classroom, provide them with 'data' with which to generate and evaluate different ideas in collaboration with

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adults and peers. As argued by Drayton and Falk (2001) an inquiry-based approach to learning is not only a means of fostering understandings and skills associated with scientific procedures, but is a means of learning content. Greater procedural knowledge may be informed by, and in turn inform, conceptual understanding (Rittle-Johnson, Siegler and Alibali, 1999); knowledge of content can provide the context for developing process skills, which in turn can help learners develop further concepts (Harlen and Qualter, 2004).

There is increasing evidence that positive attitudes to science, and scientific attitudes such as curiosity or respect for evidence, are fostered through practical inquiry and opportunities for children to explore their own ideas and questions. Affective factors play a significant role in learning. As argued by Perrier and Sendiyumva (2003: 1124), "The affective dimension is not just a simple catalyst, but a necessary condition for learning to occur".

There is growing attention to the role of creativity in the development of scientific ideas and strategies, both in science and in science education. This can be seen in recent publications and projects concerning research, policy and practice in science education. However as highlighted in the Final Reports of the Creative Little Scientists project (Creative Little Scientists, 2014) further work is needed to illustrate and explore how creativity might be recognized and promoted in everyday classroom experiences of science.

What are the issues for practitioners?

Key questions in developing creative, inquiry-based approaches to science include:

- What do we mean by inquiry-based science education? A variety of definitions are offered– what are some of the common characteristics of inquiry-based approaches?
- What are the connections with creativity? Creativity is often referred to in policy in rather general terms. What might this look like in the classroom?
- How might children's inquiry and creativity be recognized and fostered in everyday classroom activities?
- What factors are influential in opening up opportunities for children to build on their own ideas and questions and make decisions during inquiry processes?

Overview of the module

The module consists of the following activities:

1. **Introduction** - Why the focus on inquiry and creativity in early years science?
2. **What characteristics do you associate with creativity, science and learning and in the early years?** How are they related? Participants are encouraged to share their initial ideas. This provides a starting point for an introduction to *key features of the definition of creativity* adopted by the CEYS Project.
3. **How would you recognise creativity in examples of learning and teaching?** Participants discuss examples of lessons that undergraduate teachers in training identified as creative.
4. **Introduction to the definition of creativity in science** adopted by the CEYS Project
5. **What is meant by scientific inquiry?** Participants engage in practical activities designed to facilitate reflection on features of inquiry. Which features of inquiry did they engage in spontaneously? What aspects might need further support or encouragement? Participants then consider the opportunities this activity offered for decision making drawing on the framework *Essential features of classroom inquiry and their variations* (Barrow, 2010). Finally they reflect on the ideas and questions they generated through their activity and consider how their inquiry could be extended.
6. **What might be the advantages and disadvantages of open, guided and structured approaches to investigation?** Participants discuss the strengths and weaknesses of

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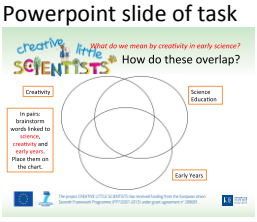
different approaches to examples of everyday classroom investigations (either an example from their own school, or the fliers example provided as a handout.) It is not intended that they carry out the investigations but reflect on

7. **What is the potential for inquiry and creativity within everyday classroom activities?** Participants review and analyse classroom examples from the Creative Little Scientists Project with a focus on the following: Which features of can you identify? What are the opportunities for children's decision-making and creativity? Do you think this is an open, guided or structured inquiry?
8. **What are the roles of the teacher in fostering inquiry and creativity in children's learning?** In what ways did the teacher foster children's independence and inquiry? What opportunities can you identify for assessment and for extending learning? Participants examine these questions in relation to two further features of the CLS Conceptual Framework: The synergies between creative and inquiry based approaches to science education and the pedagogical model *Pedagogical interventions in context* (Siraj-Blatchford et al, 2002).
9. **What are the implications for planning?** Participants reflect on how opportunities for inquiry and creativity might be extended in their own settings.
10. **Reflection**. Participants reflect on what has been gained from the module – both content and process, in relation to the aims of the workshop.

Module at a glance

Time	Task	Materials	Grouping
00.00	**1. Introduction**: aims and rationale for the module. Why the focus on inquiry and creativity in early years science?	Powerpoint presentation • Aims • Links to Curriculum Design Principles and Outcomes • Session rationale – making links to research and policy developments in the field • Outline of the session	Whole group
00.10	**2. What characteristics do you associate with creativity, science and learning in the early years?** How might they be inter-related? • *In groups of 2 or 3*– brainstorm three or four characteristics you associate each of the words - *science, creativity* and *early learning*. Write each characteristic that comes to mind on an individual post it and place in the relevant section of the chart provided (avoiding overlapping sections). • Then consider which characteristics might be shared by science, creativity and early years. Place these in the central area of the chart. • Which are <u>not</u> shared? What makes you think this? • *As a whole group* – share and record ideas about common characteristics including common skills, processes and dispositions. • Discuss areas of disagreement and characteristics that might not be shared.	Powerpoint slide of task  Small thin post-its (page markers) and pens A4 recording sheets for groups to share and sort responses. A1 Flip chart of Venn diagram to record summary of views Marker pens Blutak to display the chart for review at the end of the session.	Groups of 2/3 Followed with feedback with whole group
00.20	3. **How would you recognise creativity in examples of science learning and teaching?** • *In 2s/3s* Discuss examples of lessons taught by	Powerpoint slide of classroom examples	Groups 2/3 Followed by

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	undergraduate teacher training students, which they identified as creative. • Which examples do you think show the greatest potential for creativity and why? • Which do you consider are less creative and why? • *As a whole group* - share views • Highlight common characteristics of creative examples • Discuss areas of disagreement (related to conceptions of creativity or nature of science) • Consider distinctions between creative teaching (*teacher* creativity) and teaching for *children' s* creativity.	A4 sheets with examples given by trainee teachers. A1 flip chart and pens for recording characteristics of creative examples.	whole group
00.30	**4. Introducing definitions of creativity in learning and teaching** from the conceptual framework adopted by the CEYS project. Note comparisons with ideas shared so far and displayed on the initial Venn diagram of participants' ideas.	Power point slides Comparing IBSE and CA Definitions of creativity Creative dispositions	Whole group
00.40	**5. What is meant by scientific inquiry?** What are the key features? *In groups of 3/4* - Try out one of the practical activities provided. 1. List inquiry skills and processes you used. • Which did you engage in spontaneously? • Which might need further support/encouragement? • What is the scope for creativity? 2. What opportunities did you have for decision making? • Locate yourself on the Barrow Chart. Did this change over time? 3. What ideas and questions did you generate? • How might your inquiry be extended? • What are the implications? *As a whole group* share experiences Identify aspects of inquiry that might need particular support.	Powerpoint slides of task and of Barrow chart. Activity sheets and resources for short practical activities. Copies of Barrow chart. There are useful examples on the London Science Museum website for example Rocket Mice or Ear Gongs (www.science museum.org.uk/educators)  (These provide clear instructions, require limited equipment, can carried out quickly with rich opportunities for extension and fun!)	Groups 4
1.10	**6. What might be the advantages and disadvantages of open, guided or structured inquiry?** • *In pairs* discuss the 3 different approaches to the fliers activity shown on the sheet provided (or another common classroom investigation). • List the advantages and disadvantages of each approach. • *As a whole group* record advantages and disadvantages of each approach on a flip chart. • Consider links to your previous activity. • Do different types of inquiry have an impact on opportunities for creativity?	3 sets of instructions (open, guided, structured) for the flier activity for participants to discuss (or another common classroom activity). A1 chart for recording feedback of advantages and disadvantages of each approach. Powerpoint slide of the task	Pairs Then the whole group
1.20	Break		
1.50	**7. What is the potential for inquiry and creativity within everyday classroom examples?** • *In 4s* consider opportunities for *children's* inquiry and creativity in each example.	Powerpoint slides of : the task, key details from the episodes selected, the Barrow chart, creative	Groups of 4 divided into 2 pairs.

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	• Which features of the inquiry process are the focus of activity in each example? (For example: questioning, designing or planning investigations, gathering evidence, making connections, explaining evidence, communicating and reflecting on explanations)? • What are the opportunities for *children's* decision-making linked to the Barrow chart? • Do you think this is an example of an open, guided or structured inquiry? Why? • What evidence can you identify of children's creativity? • How could the activity be extended? • *As a whole group* share key features of the 4 different examples.	dispositions to support whole group discussion. Copies of 4 episodes or templates from CLS for example: *Selected episodes* GR Ice Balloons RO Float and Sink BE Colouring UKSC Forest School *Templates* BE The Wind UKNI Gloop Each group of 4 has 2 copies of 2 different examples to share AA3 worksheets with prompts to record their analysis.	Followed by whole class discussion.
	8. What are the roles of the teacher? • *In groups of 4* examine of the role of the teacher • In what ways do you think the teacher fostered children's creativity and inquiry? • How was support provided for children's decision making in each case? • *Whole Group discussion* • Share and record teacher approaches that fostered creativity – consider connections to the synergies between inquiry-based and creative approaches? • Highlight importance of classroom context – both pedagogical framing and pedagogical interactions.	Powerpoint slides of: the task, *Pedagogical model* (Siraj-Blatchford et al 2002), *pedagogical synergies* between IBSE and CA. Flip and pens to record responses	
2.30	**9. Implications for planning** • Take a favourite science activity you carry out in your setting. How could opportunities for creativity be extended? • What could you feed back to colleagues: What does it mean to teach science creatively? Why does it matter? • What are the implications for addressing curriculum requirements in your setting?	Powerpoint slides of activity Flip chart and pens to record feedback	Individual reflection followed by Whole group
2.45	**10. Reflections on what has been gained from the workshop.** • *In groups 2/3s* Look back at your original ideas about connections between science/creativity/ early. Anything you might add or change? Add in any additional comments or issues in another colour (pen/post it). • Note and record 2 actions you will take building on workshop content. • In what ways did the different activities support your developing thinking? • How far have the aims of the session been met? • Complete module evaluation	Powerpoint slides of activity and aims Original recording Pens, post its Flip chart Evaluation form	Groups of 4/5 For activities Sharing with the whole group
3.00	**End**		

Teacher education pedagogy

The introductory activities are designed to encourage participants to reflect on initial ideas about inquiry and creativity. Recording these processes helps to provide a starting point for introducing features of the Conceptual Framework adopted by the CEYS project and a reference point for review at the end of the session. It is important in each activity to encourage participants to offer reasons for their views and to foster exchange of alternative views. Common areas for discussion include:

- General association of creativity with creative arts activities, whether developing knowledge and understanding in science involves creativity. Use of post-its encourages discussion of choices of where to place characteristics – allows flexibility in comparison to immediate positioning on the record sheet.
- Need to make a distinction between *teacher* creativity (often involving choice of motivating contexts and resources) and teaching for *children's* creativity (for example: opportunities for children's decision making, building on children's ideas and questions, safe climate that encourages risk taking).

1. Introduction - this indicates the aims of the session and outlines factors that have led to an increased emphasis on inquiry-based science.

2. Characteristics of creativity, science and learning in the early years. This activity is designed to encourage participants to reflect on their ideas about the characteristics of creativity, science and learning - often not made explicit. This provides a useful starting point for discussion across the session, as well as a reference point for reflection at the end.

3. How would you recognise creativity in examples of science learning and teaching? Discussing classroom examples is often helpful in clarifying teachers' thoughts and ideas about creativity in science might look like.

4. Introducing definitions of creativity in learning and teaching from the CEYS conceptual framework. Here it is useful to make with participants' responses to activities 1 and 2 and to encourage them to reflect on similarities and differences in their views – and any new perspectives the framework offers.

5. What is meant by scientific inquiry? Undertaking practical tasks can help teachers to appreciate features of inquiry at first hand. The examples from the London Science Museum are just examples. A wide range of investigations could be used here – they need to engage participants quickly and be simple to resource. These have the benefit of ready-made instructions, accessible resources and appeal to adults as well as children. They are also practical for use in shorter staff training or workshop sessions.

6. What might be the advantages and disadvantages of open, guided and structured approaches to inquiry? Again there are many possible examples that could be used for this activity. The flier example is easy to imagine and discuss and it is not intended that participants undertake this activity. However, if you have the time they could try out the different approaches to the flier activity themselves. The issues involved could be explored in detail through the workshop *Comparing Approaches to Hands-On Science* developed by the Institute of Inquiry that can be found on http://www.exploratorium.edu/ifi.

7. What is the potential for inquiry and creativity within everyday classroom examples? It is important to emphasise that the focus of this task is on evidence of *children's* inquiry and creativity. The classroom examples have considerable potential to foster interest and encourage debate. However participants may need support initially in engaging with the evidence shown in the episodes and templates. It is helpful if the module facilitators are

familiar with the background to the episodes/templates selected and provide a brief introduction to each one at the start of the activity. Details can be found in the relevant Country Reports found on the CLS website http://www.creative-little-scientists.eu/content/deliverables under deliverables D4.3 Country Reports. Use of a recording sheet with key questions helps focus discussion explicitly on key features of inquiry and creativity and provides a basis for sharing analyses with others.

8. What are the roles of the teacher? The discussion of the role of the teacher provides a valuable starting point for introducing both the pedagogical synergies between inquiry-based and creative approaches and the pedagogical model (Siraj-Blatchford et al 2002) - both part of the conceptual framework adopted by the CEYS project (Creative Little Scientists, 2012). It is helpful here to encourage participants to focus on *positive* features of teachers' practice and then share and discuss possible alternative practices and extensions. This reflects an important principle of the CEYS project – identification of potential in often challenging circumstances, and recognition of the complexity of factors that influence practices in real contexts. For all teachers the challenge is to find ways to make steps forward by identifying opportunities for opening up practice starting from current policy and practice. This activity provides a useful foundation for the final parts of the session focusing on implications and evaluation.

9. Implications for planning. This activity is designed to encourage participants to reflect on the implications of module content for their own contexts by reflecting on a practical example.

10. Reflection. A reminder of the aims and structure of the workshop and reflection on initial ideas provide helpful starting points for evaluation. It is valuable if you have the time to encourage participants not just to reflect on content but on workshop *processes*.

Background reading

Defining creativity in early years science

D6.6 Recommendations to Policy Makers and Stakeholders on Creativity and Early Years Science EXECUTIVE SUMMARY

This module draws on both the definition of creativity in early years science developed in the Creative Little Scientists project and adopted by the CEYS project and key features of inquiry -based approaches to science education. You may find it useful to provide opportunities for participants to become familiar with these prior to the workshop. This report from the Creative little Scientists project provides accessible introductions to the definitions of creativity and inquiry used during the session, with illustrations from the classroom. It can be found on the CLS website at http://www.creative-little-scientists.eu/content/deliverables.

Cremin, T. et al (2015) Creative Little Scientists: exploring pedagogical synergies between inquiry-based and creative approaches in early years science. *Education 3-13*, *43*(4), 404-419.

This article built on the work of the Creative Little Scientists Project provides a useful introduction to the pedagogical synergies identified by the project between IBSE and CA to science learning and teaching.

Newton, D. P. and Newton L. D. (2009) Some student teachers' conceptions of creativity in school science, *Research in Science & Technological Education*, 27(1), pp 45-60.

This article by Newton and Newton reports findings from their study of teachers' view of creativity in science and highlights common issues and challenges.

The nature of inquiry-based approaches to science education.

The articles below give a flavour of key features of inquiry based-approaches and current areas of debate.

Asay, L. D., & Orgill, M. K. (2010). Analysis of essential features of inquiry found in articles published in The Science Teacher, 1998-2007. *Journal of Science Teacher Education,* 21(1), 57-79.
In order to provide a picture of how inquiry is practised in everyday science classrooms, the authors analysed articles published in The Science Teacher from 1998 – 2007 for explicit evidence of features of inquiry.

Barrow, L. H. (2010). Encouraging creativity with scientific inquiry. Creative Education, 1(1), 3.
This provides a useful framework for assessing opportunities for children's decision making and creativity in scientific inquiry.

Fibonnaci Project (2012) has a number of *resources* on the project website http://www.fibonacci-project.eu to support inquiry-based approaches to science teaching including:
Learning Through Inquiry - a very accessible guide to inquiry-based approaches in science
Tools for Enhancing Inquiry in Science Education - The "self-reflection tool for teachers" in this document provides a valuable framework for reflecting on features of inquiry in a classroom session with prompts in relation to both teaching and learning (both as an individual and in groups).

Minner, D.D. et al (2010). Inquiry-based instruction – what is it and why does it matter? Results from a research synthesis years 1984-2002. *Journal of Research in Science Teaching*. 47 (4), 474-96.
This article is based on a sysnthesis of research carried out between 1984 – 2002. Findings indicate a clear, positive trend favouring inquiry- based instructional practices, particularly instruction that emphasizes students' active thinking and drawing conclusions from data.

Wellcome Trust (2011) Perspectives on Education: Inquiry-based learning. London. Wellcome Trust.
This report was produced to contribute to debate about what is meant by inquiry- based education and its role in inspiring science education.

Suggested classroom examples for use during the module

The following classroom examples would act as useful starting points for discussion.

From the *Creative Little Scientists* project at http://www.creative-little-scientists.eu/content/deliverables.
Selected Classroom Episodes: GR Ice Balloons, RO Float and Sink, BE Colouring, UKSC Forest School in D4.4 Appendix Selected Episodes of Practice
Classroom Templates: BE The Wind, UKNI Gloop in Addendum to D5.3.

From the *Creativity in Early Years Science Project at* http://www.ceys-project.eu
Curriculum Materials

Title	Age group	Country
Everyday materials	5-6	England
An icy adventure	3-4	England
Water resistance	5-6	Belgium
Oxygen	4-5	Belgium
Germination and growth	5-6	Romania
Plant and Butterfly Cycles	5-6	Greece

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However it is important to review and select examples appropriate to your context and audience. Other examples can be found on the CLS and CEYS websites.

Module resources

The following documents are provided as separate files in the Module folder for adaptation and use as appropriate during the module:

- Powerpoint presentation
- Practical activities with list of resources – Rocket Mice and Ear Gongs
- Recording sheets for the different activities:
  - Task 2 recording sheet - What characteristics do you associate with science, creativity and early years? How might they be inter-related?
  - Task 7 recording sheet: Discussion of classroom examples: Evidence of children's inquiry and creativity. This can be reproduced as an A3 sheet for participants to record responses to task 7.
- Handouts
  - Task 3 Sheet of examples of lessons taught by trainee teachers that they thought were creative.
  - Sheet showing definitions of creativity in early years science and Features of inquiry and creative dispositions - for reference during the session
  - Barrow chart of opportunities for children's decision-making within scientific inquiry
  - Task 5 Open, Guided or Structured Inquiry? Written examples of different approaches to the flier investigation that can be used as a starting point for discussion.

References

Drayton, B. And Falk, J. (2001). Tell-tale signs of the inquiry-oriented classroom. *NASSP Bulletin*, 85(623), 24-34

Harlen, W. and Qualter, A. (2004). *The teaching of science in primary schools* London: David Fulton.

Harlen, W. (2001) The Assessment of Scientific Literacy in the OECD/PISA Project. *Studies in Science Education*, 36 (1), 79-104.

Perrier, F. and Nsengiyumva, J. B. (2003). Active science as a contribution to the trauma recovery process: Preliminary indications with orphans from the 1994 genocide in Rwanda. *International Journal of Science Education,* 25(9), 1111-1128.

Rittle-Johnson, B., Siegler, R. S., And Alibali, M. W. (1999). Conceptual and procedural knowledge of mathematics: Does one lead to the other? *Journal of Educational Psychology*, 91(1), 175-189.

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Appendix 2 Overview of the CEYS Training Course: Links to Content Design Principles and Outcomes

Content Design Principles and linked Teacher Outcomes		Links to Training Modules
1.	Teacher education should provide content knowledge about science and mathematics, including interesting and current topics, to be used in activities linked with everyday life.	**9, 14**
1.1	*Teachers should be able to pursue the social and affective objectives of children's science and mathematics learning, in synergy with the corresponding cognitive ones*	**14**
1.2	*Teachers should be able to make children aware of connections between science and mathematics learning and their everyday lives, in order to engage their motivation, interest and enjoyment in science and mathematics and foster curiosity and creativity.*	**9**
2.	Teacher education should provide teachers with skills and competences to carry out practical investigations of science and mathematics in the classroom.	**5, 18**
2.1	*Teachers should be able to instigate and involve children in the design and conduct of practical investigations of science and mathematics in the classroom, as such activities can contribute to the development of children's creativity.*	**5**
2.2	*Teachers should have a more detailed knowledge about the nature of inquiry and investigations in early years science and mathematics in order to be able to recognise the opportunities they offer both for creative learning and developing children's creativity.*	**18**
3.	Teacher education should advance teachers' understandings about the nature of science and how scientists work, confronting stereotypical images of science and scientists.	**3, 12, 17, 18**
3.1	*Teachers should be able to advance children's understanding about the nature of science and how scientists work, confronting stereotypical images of science and scientists.*	**3, 18**

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3.2	*Teachers should be able to recognize young children's capabilities to engage with processes associated with the evaluation as well as generation of ideas in science and mathematics, since these processes are also important for the development of learner creativity.*	**3, 12, 17**
3.3	*Teachers should be able to use foster the processes of imagination, reflection and consideration of alternative ideas in supporting children's understanding of scientific ideas and procedures and development of creativity.*	**3, 12, 17**
4.	Teacher education should promote understandings about the nature and framings of creativity, characteristics of creative teaching and learning, and how creativity is manifest in early years science and mathematics.	**19**
4.1	*Teachers should be able to recognize how creativity is manifest in early years science and mathematics and have knowledge of distinctions between features of creative teaching and creative learning.*	**19**
5.	Teacher education should provide knowledge about how children's creativity development could be enhanced and assessed within science and mathematics education.	**19**
5.1	*Teachers should have detailed knowledge about the synergies between inquiry and creativity, such as play and exploration, motivation and affect, dialogue and collaboration, problem solving and agency, questioning and curiosity, reflection and reasoning; and teacher scaffolding and involvement, to support children's creative learning and advance their creativity within science and mathematics education*	**19**
6.	Teacher education should provide pedagogical content knowledge to stimulate inquiry and problem solving in science and mathematics education.	**1, 14, 15, 17, 18, 19**
6.1	*Teachers should have knowledge of all essential features of inquiry and problem solving (questioning, designing or planning investigations, gathering evidence, making connections, explaining evidence, communicating and reflecting on explanations), their different purposes, degrees of structure and guidance (including open, guided and structured inquiries), and varied opportunities they offer for creativity.*	**18**
6.2	*Teachers should be able to open up everyday learning activities to allow greater opportunities for inquiry, problem solving and scope for creativity.*	**4, 15**
6.3	*Teachers should be able to recognise the key roles of children's questioning and existing ideas (both implicit and explicit) of science and mathematics.*	**1, 4, 14**
6.4	*Teachers should be able to use a variety of strategies for eliciting and building on children's questions and ideas during inquiry processes (before, during and after explorations and investigations).*	**1, 4, 14**
6.5	*Teachers should be able to foster opportunities for children's agency and creativity in learning in inquiry and problem solving – in particular the importance of children making their own decisions during inquiry processes, making their own connections between questions, planning and evaluating evidence, and reflecting on outcomes.*	**4, 17, 18, 19**

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7.	Teacher education should familiarise teachers with a range of formal and informal inquiry- and creativity-based learning, teaching and assessment approaches and strategies and their use in relation to authentic problems within the areas of science and mathematics.	**2, 7, 9, 11, 14, 16, 17, 20**
7.1	*Teachers should have knowledge of a range of formal, non-formal and informal learning, teaching and assessment approaches and strategies to promote creativity in their early years science and mathematics classroom.*	**16**
7.2	*Teacher should be able to use a range of strategies both formal and informal for supporting children's extended engagement with an area of study and progression in learning in science and mathematics.*	**14, 20**
7.3	*Teachers should be able to recognize and exploit the value of play and exploration in science and mathematics for fostering and extending inquiry and creativity, by for example prompting questions, eliciting ideas, providing opportunities for consideration of alternative strategies during children's familiarisation with phenomena and events.*	**7**
7.4	*Teacher should be able both to build in new and to make the most of existing opportunities for child-initiated play, recognising and capitalising on the potential of children's explorations beyond the teacher's original intentions.*	**7, 16**
7.5	*Teachers should be able to use a range of creative contexts and approaches for provoking children's interest, motivation and enjoyment in science and mathematics, such as stories, poems, songs, drama, puppets, games.*	**2**
7.6	*Teachers should be able to use strategies for making and building on science and mathematics real life connections and applications for engaging creatively young children in science and mathematics learning.*	**11**
7.7	*Teachers should be able to assume a variety of roles in their interactions with the children e.g. allower, leader, afforder, coordinator, supporter, tutor, motivator and facilitator, to support children's creativity and inquiry in science and mathematics.*	**9**
7.8	*Teacher should be able to use a variety of scaffolding techniques to promote creativity in science and mathematics, from standing back in order to observe, listen and build from the children's interests, to intervening with appropriate questioning to support and extend inquiries.*	**9**
7.9	*Teachers should be able to use different assessment approaches and strategies and in particular those that involve children in the assessment processes, such as peer and self assessment, dialogue and feedback on progress, in the early years science and mathematics classroom.*	**17**
7.10	*Teachers should value and be able to make use of varied forms of assessment evidence (including children's portfolios, individual or group records of activities), both to promote creative learning, through reflection and discussion in science and mathematics, and explicitly to inform teaching and longer term planning.*	**16**
8.	Teacher education should enable teachers to design and assess creativity-enabling inquiry-based activities which are child-friendly and include both guided and open inquiries.	**7, 16**

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8.1	*Teachers should be able to design and assess open-ended learning activities.*	**7, 16**
9.	Teacher education should enable teachers to make best use of and assess the various modes of expression and representation of science and mathematics learning to support inquiry and the development of creativity.	**8, 13, 16**
9.1	*Teachers should be able to recognize and value children's various forms of expression and representation of their ideas and learning in science and mathematics.*	**8**
9.2	*Teachers should be able to make best use of children's preferred forms of expression and representation of their science and mathematics ideas to support inquiry and their creativity development.*	**8**
9.3	*Teachers should be able to select and use different approaches for and forms of recording children's ideas and learning in science and mathematics at different stages of the learning process and for various purposes, including to support children's reflection and reasoning processes.*	**8, 13**
9.4	*Teachers should be able to use the various modes of children's expression and representation of science and mathematics ideas (e.g. pictures, graphs, gestures, physical activities) for assessment purposes.*	**8, 16**
10.	Teacher education should enable teachers to recognize and build on children's ideas, theories and interests for the teaching of science and mathematics.	**1, 14**
10.1	*Teachers should be able to use a range of strategies for picking up on children's ideas, theories and interests.*	**1, 14**
10.2	*Teachers should be able to build flexibility into planning to take advantage of unexpected events, children's interests and questions.*	**1, 14**
11.	Teacher education should enable teachers to use questioning effectively and encourage children's questions in order to foster creativity and inquiry	**1, 9, 12**
11.1	*Teacher should be able to use different forms of questioning at appropriate points to scaffold creative learning outcomes in science and mathematics, and in particular to encourage children's reflections and explanations, foster their independence and extend their inquiry.*	**1, 9, 12**
11.2	*Teachers should value and be able to build on the potential of children's own questions to foster their curiosity in science and mathematics, and support their generation and follow up, including those that are investigable.*	**1, 9**
12.	Teacher education should provide knowledge about early child development, the purposes and aims of science and mathematics education, and their place in the early years curriculum.	**15, 19**
12.1	*Teachers should have knowledge of the various purposes and aims of science and mathematics education in compulsory schooling.*	**15**
12.2	*Teachers should have knowledge of the prevailing academic rationale for the place of science and mathematics in the early years curriculum.*	**15**

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12.3 Teachers should have knowledge of the role of creativity in child development and in the fields of science and mathematics.	**19**
12.4 Teachers should be able to contribute towards the goal of preparing creative citizens, who have scientific and mathematic literacy.	**15**
12.5 Teacher should be able to align the aims and rationale for early years science and mathematics education with their teaching and assessment approaches and priorities.	**15**
12.6 Teachers should be able to support the diverse interests and needs of young children in engaging creatively within the fields of science and mathematics.	**19**
13. Teacher education should provide teachers with knowledge about the relevant education policy guidelines and documents for science, and mathematics education (and the role of creativity in them) at national level, as well as about the corresponding policy trends at European level.	**15**
13.1 Teachers should have knowledge about the relevant education policy guidelines and documents for science, and mathematics education (and the role of creativity in them) at national level, as well as about the corresponding policy trends at European level.	**15**
14. Teacher education should equip teachers with knowledge and skills to use a range of formal, non-formal and informal learning environments, including the outdoor environment, both the school grounds and the wider environment beyond the school, in their teaching of science and mathematics.	**2, 11, 20**
14.1 Teachers should be able to make use of varied settings for science and mathematics learning, including flexible use of the environment both indoors and out.	**2, 11**
14.2 Teachers should be able to recognise and build on opportunities for informal learning in science and mathematics within the school environment, for example within day to day routines or child-initiated games and other activities in school classrooms or outdoor play areas.	**11, 20**
14.3 Teachers should be able to elicit and build on children's informal learning of science and mathematics outside school, at home or in the wider environment.	**11, 20**
14.4 Teachers should be able to manage visits with children to the outdoor and wider environment beyond the school, addressing issues of health and safety, liaison with parents, building progression in experience inside the classroom.	**2**
15. Teacher education should promote teachers' use of group work to support children's inquiry processes and creative learning.	**6, 12**
15.1 Teachers should have knowledge of the value of collaboration for inquiry and creative thinking and learning.	**6**
15.2 Teachers should be able to purposefully use a variety of patterns of collaboration, shifting between individual and collaborative activity over time, to support children's inquiry processes and creative learning.	**6**

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15.3	*Teachers should be able to organize group work, aligning ways of grouping children, task design, teaching and assessment strategies in different ways to promote collaboration amongst children in science and mathematics.*	**6**
15.4	*Teachers should be able to use resources and teacher intervention appropriately to foster collaboration in science and mathematics.*	**6**
15.5	*Teachers should be able to assess group work.*	**6**
15.6	*Teachers should be able to use effective strategies for sharing ideas and discussions from different groups.*	**6, 12**
16.	Teacher education should provide teachers with knowledge of approaches to timetabling and organizing cross-curricular project work.	**10, 15**
16.1	*Teacher should be able to use approaches to cross- thematic, cross-curricular and project work to promote creativity in science and mathematics.*	**10**
16.2	*Teachers should be able to use a variety of approaches to timetabling, within the existing curriculum and policy expectations to allow space for cross-curricula project work and child-initiated exploration and inquiry.*	**15**
16.3	*Teachers should be able to build connections across the curriculum of various kinds and with potential to contribute to children's inquiry and creativity.*	**10**
17.	Teacher education should address with teachers issues in ensuring rich provision, planning and use of resources (including digital resources) in and out of the classroom to support children's inquiry and creativity.	**5, 11, 13, 15, 16, 20**
17.1	*Teachers should be able to organise and use materials (including everyday materials), resources (including ICT and natural resources) and equipment (including digital equipment and simple laboratory instruments) in the classroom, school and wider environment, both indoors and out, to support independent inquiry and creativity.*	**2, 5, 20**
17.2	*Teachers should be able to recognize the nature and potential of different materials and resources both to constrain and extend children's explorations.*	**2, 7**
17.3	*Teachers should be able to evaluate and select creativity enabling ICT resources for children to use in their inquiry.*	**2, 13**
17.4	*Teachers should be able to evaluate provision for free flow play in their school settings.*	**7, 20**
17.5	*Teachers should be able to develop and extend their own classroom resources to foster creativity in the early years science and mathematics classroom.*	**15**
17.6	*Teachers should be able to gain insights into children's developing explorations and creativity based on their use of resources.*	**7, 16**
17.7	*Teachers should be able to develop the school grounds and the outdoor classroom for use in science and mathematics education.*	**11**
18.	Teacher education should encourage and assess the development of teachers' literacy, numeracy and digital literacy skills through science	**13**

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and mathematics.	
18.1 Teachers should develop their literacy, numeracy and digital literacy skills through science and mathematics.	**13**

Appendix 3 Suggested use of Curriculum Materials in Training Modules

Module	Title Curriculum Materials	Age group	Country	Languages			
				English	Dutch	Greek	Romanian
1 Using Questions							
	Life cycle of a frog	4-5	England	✓	✓	✓	✓
	Living things and their habitats	7-8	England	✓			
	An icy adventure	3-4	England	✓		✓	
	Water resistance	5-6	Belgium	✓	✓	✓	✓
	On the go	4-7	England	✓	✓	✓	✓
	Changing Seasons	3-4	England	✓			
	Make bread right now	5-6	Romania	✓	✓	✓	✓
2. Resources and learning environment							
	Bath bombs	3-5	England	✓	✓	✓	✓
	Skeletons	7-8	England	✓	✓	✓	✓
	Crime scene investigation	7-8	England	✓			
	Electricity	4-5	England	✓			
	An icy adventure	3-4	England	✓		✓	
	Science from stories: Investigating materials	4-5	England	✓			
	Make bread right now	5-6	Romania	✓	✓	✓	✓
	Exploring materials: Can water be transferred?	4-5	Romania	✓			✓
3.Focus on the nature of science							
	Skeletons	7-8	England	✓	✓	✓	✓
	Plants	4-6	Greece	✓	✓	✓	✓
4. Focus on IBSE							
	Everyday materials	5-6	England	✓			
	An icy adventure	3-4	England	✓			
	Water resistance	5-6	Belgium	✓	✓	✓	✓
	Oxygen	4-5	Belgium	✓	✓		
	Germination and growth	5-6	Romania	✓	✓	✓	✓
	Plant and Butterfly Cycles	5-6	Greece	✓		✓	
5.Focus on practical investigation which fosters creativity							
	Air resistance	5-6	England	✓			
	Emma and her food preferences	4-5	Romania	✓			✓
	Investigating Snails	3-4	England	✓			
	The Rainbow	3-6	Romania	✓			✓
	Make bread right now	5-6	Romania	✓	✓	✓	✓
	Floating boats	5-6	Greece	✓	✓	✓	✓
	Plant and Butterfly Cycles	5-6	Greece	✓		✓	
	The sounds around us	6-7	Greece	✓		✓	
6. Collaboration and group work							
	Crime Scene investigation	7-8	England	✓			
	Everyday materials	5-6	England	✓			
	A wisp of air	7-8	Belgium	✓	✓	✓	✓
	The liquid tower	6-7	Belgium	✓	✓		
	Properties of materials: problem solving and reasoning	4-5	England	✓			
	Bath bombs	3-5	England	✓	✓	✓	✓
	Investigating Materials	5-6	England	✓			
	Bees and their communities	4-5	Greece	✓		✓	
7. Role play and exploration							
	Electricity	4-5	England	✓			
	An icy adventure	3-4	England	✓		✓	
	Super soup	4-6	Belgium	✓	✓		
	Water resistance	5-6	Belgium	✓	✓	✓	✓
	The sounds around us	6-7	Greece	✓		✓	

Erasmus+

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Module	Title Curriculum Materials	Age group	Country	Languages			
				English	Dutch	Greek	Romanian
8. Varied modes of expression and representation							
	Life cycle of the frog	4-5	England	✓	✓	✓	✓
	Electricity	4-5	England	✓			
	A wisp of air	7-8	Belgium	✓	✓	✓	✓
	Super soup	4-6	Belgium	✓	✓		
	Oxygen	4-5	Belgium	✓	✓		
	Floating boats	5-6	Greece	✓	✓	✓	✓
	Plants	4-6	Greece	✓	✓	✓	✓
	Plant and Butterfly Cycles	5-6	Greece	✓		✓	
	Bees and their communities	4-5	Greece	✓		✓	
	The sounds around us	6-7	Greece	✓		✓	
	The rainbow	3-6	Romania	✓			✓
9. Role of the teacher							
	Properties of materials: problem solving and reasoning	4-5	England	✓			
	Everyday materials	5-6	England	✓			
	Science from Stories: Investigating materials	4-5	England	✓			
	An icy adventure	3-4	England	✓			
	Floating boats	5-6	Greece	✓	✓	✓	✓
	Plant and Butterfly Cycles	5-6	Greece	✓		✓	
10. Cross curricular project work							
	Crime Scene Investigation	7-8	England	✓			
	Air resistance	5-6	England	✓			
	Science from stories: Investigating materials through stories	4-5	England	✓			
	Emma and her food preferences	4-5	Romania	✓			✓
	Bees and their communities	4-5	Greece	✓		✓	
	The sounds around us	6-7	Greece	✓		✓	
11. Linking learning in and outside school							
	Crime Scene investigation	7-8	England	✓			
	Living things and their habitats	6-7	England	✓			
	Any icy adventure	3-4	England	✓		✓	
	Air resistance	5-6	England	✓			
	Science from stories: investigating materials	4-5	England	✓			
	Bath bombs	3-5	England	✓			
	Plants	4-6	Greece	✓	✓	✓	✓
	Plant and Butterfly Cycles	5-6	Greece	✓		✓	
	Bees and their communities	4-5	Greece	✓		✓	
12. Reflection and reasoning							
	Crime Scene investigation	7-8	England	✓			
	Electricity	4-5	England	✓			
	Air resistance	5-6	England	✓			
	An icy adventure	3-4	England	✓		✓	
	Castles and moats	4-5	England	✓			
	Investigating Snails	3-4	England	✓			
	Floating boats	5-6	Greece	✓	✓	✓	✓
	The sounds around us	6-7	Greece	✓		✓	
13. ICT to enhance inquiry							
	Crime Scene investigation	7-8	England	✓			
	Life cycle of a frog	4-5	England	✓	✓	✓	✓
	Study of simple physical phenomena	4-6	Greece	✓		✓	
	Bees and their communities	4-5	Greece	✓		✓	
	Investigating Materials	5-6	England	✓			
	The sounds around us	6-7	Greece	✓		✓	

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				English	Dutch	Greek	Romanian
14. Planning for progression							
	Life cycle of a frog	4-5	England	✓	✓	✓	✓
	Electricity	4-5	England	✓			
	Living things and their habitats	6-7	England	✓			
	Skeletons	7-8	England	✓	✓	✓	✓
	Air resistance	5-6	England	✓			
	Science from Stories: investigating materials	4-5	England	✓			
	Bath bombs	3-5	England	✓			
15. Interpreting policy							
	Crime scene investigation	7-8	England	✓			
	Everyday materials	5-6	England	✓			
	Skeletons	7-8	England	✓	✓	✓	✓
	Electricity	4-5	England	✓			
	On the go	4-7	England	✓	✓	✓	✓
16. Assessment for learning							
	Life cycle of a frog	4-5	England	✓	✓	✓	✓
	An icy adventure	3-4	England	✓		✓	
	Electricity	4-5	England	✓			
	Skeletons	7-8	England	✓	✓	✓	✓
	Living things and their habitats	6-7	England	✓			
	Bath bombs	3-5	England	✓	✓	✓	✓
	On the go	4-7	England	✓	✓	✓	✓
	Floating boats	5-6	Greece	✓	✓	✓	✓
	The sounds around us	6-7	Greece	✓		✓	
17. Involving children in assessment							
	Super soup	4-6	Belgium	✓	✓		
	Oxygen	4-5	Belgium	✓	✓		
	Living things and their habitats	7-8	England	✓			
18. Nature of inquiry							
	Skeletons	7-8	England	✓	✓	✓	✓
	Crime scene investigation	7-8	England	✓			
	Life cycle of a frog	4-5	England	✓	✓	✓	✓
	Plants	4-6	Greece	✓	✓	✓	✓
	The sounds around us	6-7	Greece	✓		✓	
19. Nature of creativity							
	Materials	5-6	England	✓			
	Snails	3-4	England	✓			
20. Structured and unstructured play and exploration							
	Properties of materials: problem solving and reasoning	4-5	England	✓			
	Electricity	4-5	England	✓			
	Air resistance	5-6	England	✓			
	An icy adventure	3-4	England	✓		✓	
	Exploring Materials: Can water be transferred?	4-5	Romania	✓			✓
	Plants	4-6	Greece	✓	✓	✓	✓
	Floating boats	5-6	Greece	✓	✓	✓	✓
	The sounds around us	6-7	Greece	✓		✓	
	The rainbow	3-6	Romania	✓			✓

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