Module 11: Linking learning in and outside school

Aims of the module:

- Introduce participants to the importance of formal, non-fomal and informal learning.
- Introduce participants to a flexible use of the environment both indoors and out for science learning
- Share strategies for informal learning in science within the school environment and other activities in school classrooms or outdoor play areas
- Offer guidance on developing the school grounds and the outdoor classroom for use in science education
- Engage participants in sharing ideas of how to use outdoor learning, informal and non-formal learning to enhance formal learning.

Links to the Content Design Principles and Outcomes

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.

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.

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.

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.

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.

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.

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.

17.7 Teachers should be able to develop the school grounds and the outdoor classroom for use in science and mathematics education.

Rationale for the module

What is the importance of outdoor, informal and non-formal learning in early year science?
Preschool children are even at a very young age capable of complex, scientific reasoning. Important contexts for early childhood science learning include (CAISE, n.d. and authors mentioned within):

- Everyday settings, such as talking with parents or exploring the natural world
- Designed informal learning environments, such as children's museum or science center
- Formal education institutions, such as (pre)school

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A rich learning environment stimulates curiosity, and may trigger children to question the world around them. Taking pupils out of the classroom and working in an **outdoor environment** for a part of their time in school can foster their creative development. The reason for this may be that pupils feel as if they own outdoor time more than indoor time. Moreover, pupils link indoor time to individual working. So ownership and collaboration may be enhanced by outdoor education. An initial walk with young pupils can provide a rich context for discovering children's interests on which teachers can build to enhance their creativity (Davies et al., 2013)). Besides this, learning outcomes from field trips can range from cognitive to affective outcomes. Too often, however, only cognitive gains are identified (by schools or museums)(CAISE, n.d.).
Learning outside the classroom builds bridges between theory and reality, schools and communities, young people and their futures. Qualitative learning experiences in 'real' situations attribute to achievement and better personal and social skills. These experiences can (The Department for Education and Skills, 2006):

1. Improve academic achievement.
2. Provide a bridge to higher order learning.
3. Develop skills and independence in a widening range of environments.
4. Make learning more engaging and relevant to young people.
5. Develop active citizens and stewards of the environment.
6. Nurture creativity.
7. Provide opportunities for informal learning through play.
8. Reduce behaviour problems and improve attendance.
9. Stimulate, inspire and improve motivation.
10. Develop the ability to deal with uncertainty.
11. Provide challenge and the opportunity to take acceptable levels of risk.
12. Improve young people's attitudes to learning.

Young children need the experiential base of being outdoors. The knowledge they gain there provides the basis for science learning. Moreover, these outdoors experiences seem lasting. Surveys of adults point out a high quotient of happy outdoor memories, some of which have been formative. Another lasting benefit is that children can learn to care for the environment, if provided with numerous positive outdoor experiences with suitable role models (Rivkin, 2000)

Even when a child is in full-time education, up to 80 percent of their waking hours are spent outside of school (Wellcome, 2012). What makes **informal learning** attractive is its purely interest-driven, voluntary, self-directed, hands-on, and authentic nature. Informal learning may foster positive attitudes and intrinsic interest in science. Informal science learning occurs when children can pursue their curiosity without having to worry about any formal assessment. Informal science learning is authentic because learning occurs in interaction with their social and physical environments (Asghar, 2012). Moreover, informal science learning may be particularly beneficial for young people from socially disadvantaged backgrounds. They often consider science subjects challenging and unengaging at school. (Wellcome, 2012). During informal learning moments children tinker, experiment, and "mess around" with things as settings are relaxed. During the process of "messing around", meanings are made. The children themselves "organize learning into more structured inquiry as they make sense of the messiness". (Hung et al., 2012)

Non-formal learning environments, such as museums and science centers, can contribute greatly to the understanding of science and encourage students to foster their interests outside of school. Museums, if well organized, have the potential to engage children and to

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stimulate their understanding, and most importantly these settings may help them understand their responsibility for their own future learning (Eshach, 2007). Museum exhibits and investigations can be carefully integrated into science curriculum and may (Ashgar, 2012, p.63):

- "spark students' imagination and sense of wonder about the natural world;
- stimulate their interest in particular science topics;
- develop their questions to plan and pursue scientific investigations;
- promote conceptual change through discussion, reflection, and cognitive conflict;
- organize cooperative inquiry projects,
- extend students' emerging understandings of particular scientific models;
- provide authentic problem-solving tasks;
- facilitate social interactions and cultural development.

What are the challenges for teachers?

- Linking non-formal and informal learning to formal learning is challenging, since learning is not always observed.
- Informal learning outside the classroom depends on other persons or provided contexts, which differ for every child. It is a challenge to build on these informal learning experiences and to enhance the possibilities for future informal learning.
- Making links with children's everyday lives engages interest and fosters creativity (French, 2004). There are often challenges in working out how to build on everyday life situations and use them to foster play and exploration.
- Children participating in teacher-led school fieldtrips may not be aware of any specific goals of these visits and may therefore not be ready to learn. Moreover, sometimes teachers do not have explicit goals for the visit, and are therefore unable to connect the experience to the classroom curriculum. (Eshach, 2007)
- Teachers sometimes do not recognise the opportunities these different learning environments offer. (Eshach, 2007)
- Teachers may feel intimidated when they take classes to museums. They also have many management concerns (e.g. losing children) and being asked questions which they cannot answer. (Eshach, 2007)

Overview of the module

The module consists of the following activities:

1. An **introduction** to the definition & role of formal, informal and non-formal learning to early years science learning.
2. **Expectations and questions** of the participants
3. **Own examples of outdoor, non-formal and informal learning**
4. **Exploration of the outdoor with a focus on outdoor & informal learning**: opportunities for the participants to explore outdoor possibilities and find/suggest possibilities where informal or non-formal learning may take place.
5. **Discussion of possibilities for using the outdoor environment for science learning**
6. **Characteristics of stimulating outdoor & non-formal learning**
7. **Linking informal & formal learning**
8. **Focus on the role of the teacher:** Discussion & reflection on classroom examples from CEYS
9. **Link their experiences during the module and the classroom examples to their own classroom practice**
10. **Reflections** on what has been gained from the module

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Module at a glance

Time	Task	Materials	Grouping
00.00	1. **Introduction** to the role and definition (followed in this module) of non-formal and informal learning to science education.	Powerpoint presentation • Aims – questions addressed • Links to Content Design Principles and Outcomes • Session rationale (see Support Materials below)	Whole group
00.15	**2. Expectations and questions of the teachers.** Teachers write down what they want to learn during this session and what their questions are. Run over the questions one by one and start clustering them in different emerging categories.	Post-its Pens Board or wall	Individually & whole group
00.25	**3. Own examples of outdoor, non-formal and informal learning** Hand-out the A3 recording sheet. Participants write down and discuss their initial ideas on formal, informal, non-formal and outdoor learning. Let the participants connect own examples of outdoor practice they have organized and some non-formal and informal learning they noticed to the boxes on the A3	Recording sheet with scheme (print on A3) Pens of different colours	Individually & small groups of 4-5
00.35	**4. Exploration of the outdoor with a focus on outdoor & informal learning** Divide the group in subgroups of 4-5. Give them a tablet or let them use their smartphone. Go outside (e.g. to a nearby School Playground, Garden, Parking Lot, Street, Park, Rooftop, Riverside, …). If this is not possible, let them look outside the window and explain the purpose of the exercise. The teachers explore the outdoor environment and take objects or pictures of situations/objects that could stimulate informal science learning (e.g. a sand box, interactive toys, nature, garden, …).. Emphasize that they should use all their senses. If the module takes place in a non-formal environment. This exercise could be extended to this environment.	Tablet or smartphone	Groups of 4-5
01.00	**5. Discussion of possibilities for using the outdoor environment for science learning** Invite the groups to exchange their images and objects and discuss what situations/objects could trigger (informal) science learning. - What aspects are important to trigger science learning (to gain scientific insights or trigger questions)? (e.g. experimenting, observing, socializing, …) - Let them reflect on the opportunities the outdoor environment offers to gain scientific insights, questions, skills, …	Blackboard, whiteboard or flip chart & pens	Whole group

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	- How could the school environment be improved to foster science learning? (e.g. living things, variation (hills, ponds, …), challenging toys List these on a blackboard, whiteboard or flip chart. Let them note central ideas. Let them add concrete ideas on their A3 with a different colour Prompt with: Places which can be used to: - develop physically (e.g. slides, hills, rubber walk-way, push-toys, moving things such as swings, seesaw, …) - experiment, play or observe materials (e.g. water, sand, …) - experiment, play or observe nature (garden, henhouse, forest, pond, …) - socialize (hut, …)	Recording sheet Pens of different colours	
01.15	**6. Characteristics of stimulating outdoor & non-formal learning** Next give them different pictures of opportunities for non-formal learning (e.g. zoo, science museum, bakery, good & bad practices …). Let them explore these pictures and let them write on the recording sheet. Let them discuss in small groups - What do you think is important for a non-formal environment to stimulate creativity & science? (e.g. real-life, relevant, authentic, stimulating thinking, play, questioning, …) - Do you think these would be different for other age groups? - How would you prepare a field visit? (e.g. to a museum, field trip, zoo, …) What goals might you have? - What would your role be during the visit? What would you assess during the visit? How would you use this information? - How would you follow up a field visit? (e.g. to a museum, field trip, zoo, …) Record key insights on a blackboard, whiteboard or flip chart. Complete the list with insights from research (see support materials) Let them add concrete ideas on their A3 with a different colour Prompt with: - Hands-on, interactive or static. Raising questions and promote discussion. Real-life and stimulating. Visibility of science concepts. - Goals of the fieldtrip. - Reactions, questions of children.	Blackboard, whiteboard or flip chart & pens Pictures of non-formal learning environments. If available, you could also give them tablets where they can have a virtual 360° tour at a non-formal learning environment (e.g. science museum). Recording sheet Pens of different colours	Groups of 4-5 Whole group
01.30	**7. Linking informal & formal learning** Next give the different groups different	Blackboard, whiteboard or flip chart & pens	Groups of 4-5 Whole group

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	pictures illustrating informal learning (e.g. children reading books, children at a playground with friends, watching tv, playing with parents). Let them explore these pictures and question them (see recording sheet). Let them write down ideas on the recording sheet and let them exchange in their group. - How could you as a teacher foster informal learning (in- & outside the classroom)? (e.g. inform parents about possibilities, encourage parents to experiment with their children, being a role model for the children by being inquisitive, creative, …) - Reverse the question: How could you build on (previous) informal learning in the classroom? (e.g. build on experiences of children, build on questions you hear during playtime, …) - How could you enhance informal learning in the classroom? (e.g. supply materials which encourage play and exploration, …) Discuss with the whole group the questions above: - Record key insights on a blackboard, whiteboard or flip chart. (whole group) - Complete the list with insights from research - Let them add ideas on their A3 with a different colour	Pictures of informal learning environments Recording sheet Pens of different colours	
01.45	Break		
02.00	**8. Focus on the role of the teacher** Discussion & reflection on classroom examples. - What is the role of the teacher in the episode? - How do (or could) they stimulate children to explore the outdoor environment? - How do they build on informal/non-formal learning? How do they use the outdoor environment? - What would you do (differently) in your practice? Invite each group to share their insights. - Brief feedback on each example - Record key insights on a blackboard, whiteboard or flip chart. - Introduce insights from literature sources. Connect to previously recorded insights and complete these with new insights.	Copies of episodes or templates from CLS or CEYS material. For suggestions see paragraph: *Suggested classroom examples for use during the module*. If available in your context, show video material with useful ideas of classroom practice. *For each group* Copies of 2 examples Blackboard, whiteboard or flip chart & pens Powerpoint slides Recording sheet	Groups 4/5 Work in 2/3 to discuss one example. (If time swap to discuss second example and add to the recording sheet of the other 2/3.) Feedback with whole group
02.25	**9. Link their experiences during the module and the classroom examples to their own classroom practice**. - The teachers enrich their examples (see phase 3) with new ideas. - They record general implications for planning. They note 2 or 3 actions they will take building on module content.	Recording sheet to write down ideas Pens Blackboard, whiteboard or flip chart & pens	Individually & groups of 3-4 & whole group

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	- What approaches would they find useful in stimulating informal and non-formal learning? What challenges have they faced or could they face? Exchange ideas, discuss questions and possible difficulties in pairs. - The teachers refine their ideas Interesting insights are shared with the whole group.		
2.45	**10. Reflections on what has been gained from the module** - In what ways did the different activities support your developing thinking? - How far have the questions at the start of the session been answered? Do you still have questions that need addressing?	Pens, post its Flip chart	Groups of 4/5 for activities. Sharing with the whole group.
3.00	End		

Teacher education pedagogy

If there is the opportunity to do this module in a non-formal learning environment, this may contribute to the insights of the participants.

To make the module more interactive or save some time it is possible to drop some of the recording sheets and discuss insights together or in small groups.

1. **Introduction.** This module draws on key features of informal, non-formal and outdoor learning to science education. You may find it useful to provide opportunities for participants to become familiar with these concepts during the module. Examples of relevant resources you might use are provided in the support materials below. In the powerpoint an introduction to these concepts is provided. It is important to consider that the definition of these concepts may differ according to the source. Mention this to the participants, and agree on using the concepts as they are defined in the powerpoint.
2. **Expectations and questions of the teachers**. In this early phase of the module the participants write down what they want to learn and what their questions are. The facilitator collects the post-its and runs through them one by one. They are classified in emerging categories. This enables the facilitator to focus more explicitly on the questions of the participants during the module.
3. **Own examples of outdoor, non-formal and informal learning.** Participants discuss their initial ideas on formal, informal, non-formal and outdoor learning in an interactive way. In this way it becomes clear for the module facilitator which background information this group needs. It will also be clear that different definitions about informal and non-formal learning exist. The participants write down some examples of outdoor practice they have organized and some non-formal and informal learning they noticed. By using this method teachers already write down how they work now. This information will be used at the end of the module, to help participants enrich their current activities to foster more the use of informal and non-formal learning opportunities.
4. **Exploration of the outdoor with a focus on outdoor & informal learning.** Participants prefer real-life experiences. This approach provides an opportunity to explore the possibilities of simple everyday-life environments. At the same time they try to see new opportunities in this outdoor environment to enhance science learning. Emphasize that the participants should not only use their smartphones to register experiences, but that they should use all their senses. In this way a wider variety of science experiences will emerge.

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5. **Discussion of possibilities for using the outdoor environment for science learning.** During this phase participants brainstorm to find new possibilities for informal and outdoor learning in the environment they explored. As a trainer it is important to probe for ideas by asking more in-depth questions in an interactive way. Participants should link the environment to skills and attitudes that children should develop. By adding ideas on the A3 teachers immediately link insights to their own classroom practice. These ideas can be further elaborated during phase 9. (linked to creativity in science)
6. **Characteristics of stimulating outdoor & non-formal learning.** This part of the module focuses on non-formal learning. According to literature teachers should focus more on the goals of the field-trips they organize. They do not always link these experiences with formal learning (before and after the visit). Therefore, it is important to supply possible goals and ways to connect these visits to formal learning. The use of a recording sheet ensures that everybody thinks about goals of the visit. These goals can be classified according to the goals found in literature (see support materials for more background information). Also observation/assessment by the teacher during the field trip could reveal opportunities to further build on in the classroom. The exchange in small groups provides the opportunity to everyone to share ideas. During the interactive whole group discussion key insights are recorded. By adding ideas on the A3 teachers immediately link insights to their own classroom practice. These ideas can be further elaborated during phase 9.
7. **Linking informal & formal learning.** This phase clarifies how teachers can link informal learning to formal learning. It is important to consider different possibilities: when is participation of parents required? When can children explore by themselves? It is especially important to focus on the role of the teacher: How can the teacher enable informal learning (e.g. by supplying ideas, materials to teachers)? The teacher can also show an inquisitive creative approach and in this way exemplifies what is understood by creativity & inquiry in science. The use of a recording sheet ensures that all contribute. The exchange in small groups provides the opportunity to everyone to share ideas. During the interactive whole group discussion key insights are recorded (see support materials for more background information). By adding ideas on the A3 teachers immediately link insights to their own classroom practice. These ideas can be further elaborated during phase 9.
8. **Focus on the role of the teacher.** Several CEYS-examples could be useful. However, it is important to make a selection based on the background of the participants. It might be more useful to analyse one example in-depth, than to run through different examples. The classroom examples can inspire the participants to explore more opportunities for outdoor, non-formal and informal learning. It is helpful if the facilitators are familiar with the background of the selected episode(s) and provide a brief introduction (to each one) at the start of the activity. Participants reflect interactively on the role of the teacher and how the teacher can stimulate outdoor, non-formal and informal learning and make connections with creativity and inquiry in science.
   If people want more concrete materials, offer them to send more curriculum materials to them by e-mail or advise them to visit the CEYS-website.
9. **Link their experiences during the module and the classroom examples to their own classroom practice.** The aim of this phase is to stimulate teachers to broaden en deepen their activities based on the content of the module. During this phase, they can ask questions and discuss interactively remaining difficulties. In this way, they will be more likely to incorporate their ideas in their own classroom practice.
10. **Reflections on what has been gained from the module.** During this phase the initial questions of the participants are reviewed. Remaining questions are addressed

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interactively. They are encouraged to write feedback on the process as well as the content of the module.

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.

Defining key features of informal, non-formal and outdoor learning

This module draws on both the definition of informal, non-formal and outdoor learning 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 module. For example both:

- Module 2: Resources and Learning environment as essential context factors for Creativity and Inquiry
- Module 7: Role of play and exploration in inquiry and creativity

The executive summaries of the Final Reports of the Creative little Scientists project

- D6.5 Final Report on Creativity and Science and Mathematics Education for Young Children EXECUTIVE SUMMARY
- D6.6 Recommendations to Policy Makers and Stakeholders on Creativity and Early Years Science EXECUTIVE SUMMARY

also provide an accessible introduction to the definitions of creativity and inquiry used during the session, with illustrations from the classroom. These documents can be found on the CLS website at http://www.creative-little-scientists.eu/content/deliverables.

What is informal, non-formal and formal (science) education?

Depending on the literature source different definitions of formal, informal and non-formal learning/education may be used. Below you can find some of these definitions.

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- Krishnamurthi, A., Rennie, L.J. (2012, p.1) "*Learning is often described as formal learning (such as that occurring in schools, colleges, and universities) and informal learning (that occurs everywhere else). Although the learning process is the same, there are qualitative differences between formal and informal learning contexts that hinge on the degree of choice participants have to engage in learning activities and with whom, and whether or not there is a formal curriculum and/or assessment process. Informal science education (ISE) is learning related to science that occurs in informal, out-of-school contexts. These contexts vary from visiting science centers and engaging with the exhibits and programs offered there, to watching a science program on TV, to researching a nature topic in the library or online, to participating in structured afterschool programs, and so on. Science museums, science centers, zoos, aquaria, and similar places are designed for people to pursue their interests and engage in science-related activities. Other opportunities for science-related experiences are available in afterschool programs. We define "afterschool" as programs that provide an array of safe, supervised, and structured activities for children and youth that are intentionally designed to encourage learning and social development outside of the typical school day. Programs generally operate during the hours immediately following school dismissal; however, they also include activities that occur before school, on weekends, over school breaks, and during the summer. They may be located at a school or off-site. Programs may be delivered through partnerships between public and private entities and may employ credentialed teachers and/or qualified community educators. They may be supported by parent fees or subsidized by federal, state, and local governments, grants, or philanthropic gifts, or any combination of these resources. A common element across these programs is an engaging, hands-on learning approach and less formal environment that aims to feel different from school."*

- *Eshach (2007, p.173) "Non-formal learning occurs in a planned but highly adaptable manner in institutions, organizations, and situations beyond the spheres of formal or informal education. It shares the characteristic of being mediated with formal education, but the motivation for learning may be wholly intrinsic to the learner. Informal learning applies to situations in life that come about spontaneously. Informal learning is distinguished from the other two by having no authority figure or mediator. The learner is motivated intrinsically and determines the path taken to acquire the desired knowledge, skill, or abilities*."

Table I. Differences between Formal, Non-formal and Informal Learning

Formal	Non-formal	Informal
Usually at school	At institution out of school	Everywhere
May be repressive	Usually supportive	Supportive
Structured	Structured	Unstructured
Usually prearranged	Usually prearranged	Spontaneous
Motivation is typically more extrinsic	Motivation may be extrinsic but it is typically more intrinsic	Motivation is mainly intrinsic
Compulsory	Usually voluntary	Voluntary
Teacher-led	May be guide or teacher-led	Usually learner-led
Learning is evaluated	Learning is usually not evaluated	Learning is not evaluated
Sequential	Typically non-sequential	Non-sequential

(Eshach, 2007)

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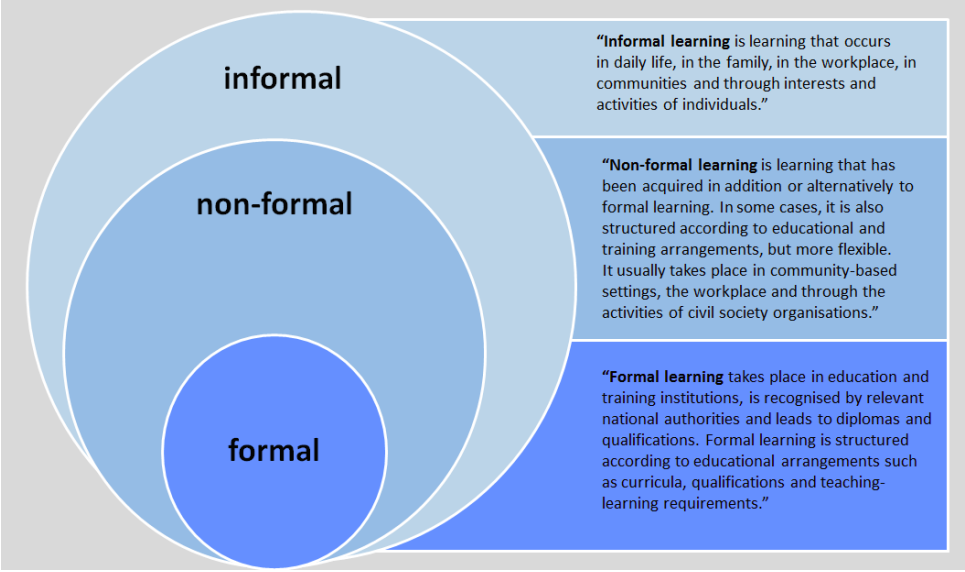

http://www.slideshare.net/LKOTZE/life-long-learning-and-planing-lesson-2

Design of outdoor environments

Rivkin (2000) provides useful and concrete information on how to design the outdoor environment depending on the age of the children:

"Design of outdoor play areas begins with the young child's needs and directions of growth. A developmentally appropriate space is a major element of the curriculum--where there is sand, there can be exploration of sand. Designs for infants, toddlers, preschoolers, and primary children differ. ***Infants*** *need modulated sensory stimulation and increasing physical opportunities. This includes interesting things to look at from a horizontal as well as vertical position, protection from excess wind and sun, pleasant colors and sounds, places to crawl and things to pull up on as they develop these skills, and the ability to watch but not be knocked over by older children. Elements to consider include waving grasses and leaves, mobiles stirred by the breeze, high vines that attract birds and butterflies, and soft wind chimes. Porches with translucent roofs, smooth floors for creeping, and vertical railings (spaced to avoid entrapment) for pulling up on, provide an outdoor experience without rain or excess sun. Ramps instead of stairs allow for safe creeping, as well as gravity experiments ("How did that ball get down there?" "Will it do it again?").* ***Toddlers*** *require places and spaces for acting out prepositions--over, under, on top of, inside, outside, behind, in front of, up, and down--because their physical development is paramount and fuels their cognitive development. In addition to safe, appropriately sized playground structures, toddlers like low hills to clamber up and down. A slide imbedded in the hill provides another way down. A large sand area, arranged to be covered when not in use, is a place for socializing. Experiencing water is vital--water table, hose, sprinkler. Trees that change colors or offer pinecones, shade, and possibly fruit are enjoyable for adults as well as children. Behind a low fence, gardens give color and fragrance but minimize contact with bees and wasps. Poured rubber walkways provide even, soft areas for practicing walking and then running, as well as for push-toys and wheeled toys. As with infants, porches extend the use of the outdoors and serve as a transitional zone between the classroom and the yard.* ***Preschoolers*** *continue rapid physical development, and with increasing social and language skills, require a yard with many opportunities. Running, climbing, hopping, jumping, sliding, dancing, and spinning require large-motor structures, trikes, wagons, wheelbarrows, hills, and paths. Sociodramatic and individual imaginative play is fundamental to preschoolers' development, and such play*

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is supported by playhouses equipped to become homes, convenience stores, forts, or restaurants as youngsters' interests require. Outdoor storage holds play props and art supplies, encouraging teachers to make art available where messes don't matter much and creation is inspired--"Can you paint the wind?" Sand and water play are also required for preschoolers' knowledge of the physical world, an entry point into play with others, and for creative expression. Gardening, especially in trike-resistant raised beds, teaches preschoolers about growing and caring for plants. Preschoolers are intrigued by the insects gardens attract, including butterflies. Outdoor storage for tools and hoses helps here; children play at gardening, teachers do the gritty maintenance work. ***Primary children*** *need much of what preschoolers need but also require places to sit, read, talk, draw, and do homework. Provision for group activities such as a basketball hoop, ground graphics such as hundred-squares and hopscotch, and an amphitheater are desirable. Materials for projects--wood, paint, cardboard, clay, tools--allow initiative and industry. In some centers, primary children enjoy being with the younger children, developing skills as mentors and play leaders. Children also benefit physically from freely playing in wooded areas (Fjortoft, in press)."*

Youth gardens support diverse learning opportunities. These may even have lasting positive impacts on their self-esteem, awareness of and concern for their environment and nature and personal and social well-being. Youth gardening may play a crucial role in making Informal Science Education accessible and mediate STEM literacy development. Youth gardening works best if children are asked to research and then enact ideas, and connecting the project to the broader community (CAISE, n.d.).

Informal learning: resources & role of the parents and teachers

Understanding the role that parents play in supporting science learning is an ongoing area of research. Parents are believed to support science learning both directly, by scaffolding learning and modeling, and by supporting interest during science-related interactions and indirectly, by providing science learning experiences and resources (such as engaging with an in-home, science-related activity, reading a science-related book together, visiting the early childhood learning space at a science center, visiting a botanical garden) (CAISE, n.d.). Parents may enhance informal learning strongly. They may improve their skills at extending the learning of their child. Boosting informal learning does not mean adding more "scholastic" activities at home. Informal learning is a child-directed activity with play as the purpose where children pursue their own interests. This cultivates their curiosity and intrinsic motivation. During informal learning children often interact with a parent or adult who provide specific and immediate feedback. Research shows this adult-child interaction accelerates learning. In school this feedback may be delayed. Informally, a child can ask questions, and get customized answers, maybe even a discussion, that addresses what's on their mind. This means learning is more fun, spontaneous, and potent. **P**arents can improve their skills at fostering learning out of school. Activities such as reading to their children, assuring homework gets done, providing resources and opportunities to cultivate talents and interests. (Arsaga, 2011)

Ways to establish stronger relationships between home and school (*Eshach, 2007)*:

- Teachers could select simple activities appropriate for children to take home and carry out with their parents. It is recommendable that the needed materials and equipment is composed of simple objects and materials found in any household. To understand science in the home, everything used should come from the home. Research indicated that most parents show real enjoyment of at least some of the activities provided by the school. In addition, in at least half of the investigations, the

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child had enough confidence to make some original contribution to the investigation. This may implant the enjoyment of science into the home culture, and through this into the child's self image and future
- children can carry out scientific and technological inquiries, first in school and then as they pursue with their families at home

Research has shown that educational media can hold significant benefits for preschool and elementary-school children's understanding of and attitudes towards science. However, they need to be well-designed. It must be designed to meet the needs, abilities, and interests of the children. Parents (and teachers) may present these educational media to their children. Important characteristics of these media (e.g., television, computer games, print) are (CAISE, n.d.):

- Appealing elements such as humor, mysteries, and games with engaging visuals, rather than static visuals or extensive dialogue
- Characters whom children see as competent and intelligent, and with whom they can identify
- Age-appropriate topics and language
- The educational content should be "on the plotline" (e.g., using a science concept to uncover the crucial clue that solves a mystery, games which require users to employ and practice the targeted skill) and it should be clear, direct, and explicit
- Concepts should be repeated over the course of a game or episode
- Drawing explicit connections to encourage children to see how similar concepts can be applied to different problems or situations
- Encouraging children to actively engage in the educational content, through either interactive gameplay or viewer participation while watching a television program (e.g., playing along with a game show, attempting to solve a problem before the on-screen characters solve it)
- Motivating children to carry learning forward via activities that extend the experience after viewing (e.g., trying a hands-on experiment that was shown on-screen, searching for additional information in books or online
- Designing feedback and hint structures to scaffold performance (e.g., by providing greater support in response to repeated errors), and to reinforce success in order to support children's self-concept of being "good at science or math"

Nowadays, projects often use more than one media platform (e.g. an television series might be accompanied by a Website, hands-on materials, or even a museum exhibit or live show). Combination of media may yield added learning: using different media platforms provide more opportunities to master the basic concepts. Moreover, children get the change to transfer the content to different situations (CAISE, n.d.).

A teacher may provide materials to children and/or parents in a class library (e.g. with books, games, media, materials, …) which can enhance informal learning and may be taken home. It is important to communicate about these possibilities with parents and caregivers so they are aware of their role in informal learning.

Opportunities & barriers to outdoor or non-formal education

Characteristics of **qualitative tours** (Eshach, 2007)

- Tours focus less on facts or stories and more on extensive ideas or concepts.
- The scientific and historical vocabularies used during the tours should be appropriate for the children.

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- Sensitivity to individual and cultural differences should be taken into account.
- Closed and/or factual questions which do not require complex responses from children should be, used less. Questions should follow-up, elaborate further, or probe.
- The structure and content of the tour provides connections between the content of exhibit halls and the lives and prior knowledge of the children. Teachers provide analogies, information, or examples related to childrens' life outside the museum.

The **barriers which teachers experience** concerning fieldtrips are (Dillon et al., 2006, p.108):

- fear and concern about health and safety;
- teachers' lack of confidence in teaching outdoors;
- school curriculum requirements;
- shortages of time, resources and support;
- wider changes within and beyond the education sector.

Research identified seven exhibit characteristics that attract and hold the attention of (family) groups in **(science) museums** (Eshach, 2007):

- Multisided: the family can cluster around the exhibit.
- Multiuser: interaction is allowed for several sets of hands (or bodies).
- Accessible: comfortably used by children and adults.
- Multioutcome: observations and outcomes are sufficiently complex to foster a group discussion.
- Multimodal: appeals to different learning styles and levels of knowledge.
- Readable: text is arranged in easily understood segments.
- Relevant: provides cognitive links to visitors' existing knowledge and experience.

In some (science) museums the fun-aspect may prevail on the learning aspect. This may result in less learning. These museums may be dissatisfying for the following reasons (Eshach, 2007):

- some of the demonstrations involve 'sloppy science',
- the real meaning is obscured,
- science and technology are presented as ethics-free
- science is dishonestly presented as easy and unproblematic.
- scientific phenomena may be presented without a conceptual framework and rather as a series of unconnected, magical events

The last reason is very serious because it doesn't reflect what science is about: the asking of questions about how the world works and it suggests that scientists are very smart. This implies that science is not for all children and students.

Museum exhibits can be either **hands-on** or **interactive** (Eshach, 2007):
Hands-on exhibits require the visitor to have some physical involvement with the exhibit (e.g. pushing buttons to highlight aspects in the exhibition). However, while hands-on exhibits are passive, interactive exhibits are active and respond to the visitor's actions. Interactive exhibits invite more actions from the visitors and result in further interactions, and a kind of man-machine dialogue is developed (e.g. changing the angle of the wings of an airplane model might change the position of the airplane).

Bridging non-formal and formal learning

An important factor to consider are defining the educational goals for the trip. How will this

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trip enhance the classroom program? What will the children do on the trip? What will they learn? (CAISE, n.d.).The reasons for planning a field-trip may differ and teachers have different views about the nature of the connections to the curriculum. Teachers, if aware of these views, are better able to decide what kind of connection they might seek for during a specific visit, and plan the visit accordingly (Eshach, 2007).

- curriculum-related experiences: students gain 'hands-on' experience related to curriculum;
- curriculum-related learning: students gain content knowledge related to the curriculum;
- connection to language skills: students utilize language skills in an interesting real-world setting;
- point-by-point connections: students are directed to see how different aspects of the museum relate to different parts of the curriculum;
- curriculum unit integration: the museum experience is an integral part of a particular topic currently being studied in class, and the experience is directly related to current activities or projects;
- curriculum unit introduction/review: students are introduced to a curriculum topic which they have not yet begun in class, or they are reminded of a curriculum topic which they have already finished;
- implicit/opportunistic connections: students naturally relate their museum experience to their classroom experience.

The roles of the teachers may involve (Hung et al., 2012)

a) helping the children articulate and reflect on their learning experiences,
b) catching moments to establish links between learning in formal and informal contexts by comparing and contrasting learning in both contexts, and
c) helping the children to transfer their learning strategies across contexts to improve their performance in formal classroom learning.

Teachers should consider the following when designing and executing scientific fieldtrips (Eshach, 2007, p.187):

- *"Decide what the purpose of the scientific fieldtrip is. For instance, is it a kind of enrichment experience that is not connected to the curriculum? Is it connected? In this case the teacher should decide whether its role is to introduce or motivate a learning topic, to summarize it, or to deepen and extend it. The purpose, of course, directs the way in which it will be conducted.*
- *Visit the fieldtrip location beforehand. Talk with the people in-charge of the educational program to inform them about the purpose of the visit and your expectations. Ask them whether they have any suggestions for activities you can do in the class before the visit and afterwards which, of course, fit the fieldtrip purpose.*
- *Share the purpose of the visit with the children before the visit and share your expectations of them. You can also ask the children whether they have any expectations of their own. In this regard it must be clear to the children that the visit is a learning experience.*
- *To decrease the novelty phenomena, the children can be presented with the structure of the day. In addition, the children may enter to the location's Internet site and become acquainted, to some extent of course, with the environment before the fieldtrip. In such a way they may feel safe not being afraid about being lost or not knowing what to do. This will also decrease concerns from the teacher's side.*
- *Conduct the relevant scientific activities in the class before going to fieldtrip. This is important because in this way the children will acquire both the skills and background knowledge they need in order to better benefit from the new experiences.*

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• *Always provide some tasks to be conducted in the fieldtrip. This is very important because such tasks may help the children to notice things that could otherwise be ignored. It is suggested that the tasks be open-ended and require observation, discussion, and deduction of ideas or principles rather than a focusing on recording of factual information. Also, it is important not to overwhelm the children with too many tasks. In this regard more is not always better. In addition, it is important to bear in mind that the child should also have the opportunity to have free choices both in what exhibits or activities he or she wants to participate in and in what manner they want to conduct it.*
• *Share with parents and encourage them to join the trip. Remember, it was found that adults' help might stimulate them and lead to longer and deeper involvement with the exhibits. For this purpose, of course, parents with some scientific background might be a good fit.*
• *It is suggested that schools prepare some activities in advance; activities that may be good for parents to join. In addition, there should be some guidance on how parents can continue those activities at home. Such activities might encourage parents to conduct scientific activities with their children. This might have a positive affect on the child's motivation, attitudes, and self image concerning science.*
• *Schools and museums should cooperate and bring some scientific activities into the classroom. In such a way there might be more and stronger interactions between schools and museums.*
• *I also call for broadening the scientific kindergarten model. Such centers, that might even be part of science museums, might better fit the activities to the children's needs.*
• *In-service courses for teachers are needed first, to increase their awareness of what out-of school learning environments may offer and second, to teach them how to execute scientific fieldtrips more effectively."*

Inspirational quotes

"It takes a village to raise a child" (African saying)
"There is only one thing more painful than learning from experience and that is not learning from experience." (Archibald MacLeish)

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: MA_Class_Minibeasts_Lenvironm; UKSC_Class_Forest_School_Child Ideas in D4.4 Appendix Selected Episodes of Practice. The pdf is available online: http://www.creative-little-scientists.eu/sites/default/files/D4.4_Appendix_3_Selected_Episodes.pdf

Classroom templates: PT_Class_SwinggameRope_IBSE in Addendum to D5.3. Templates can be found on http://www.creative-little-scientists.eu/TeacherTrainingMaterials

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

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Title	Age group	Country
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

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
- Recording sheets for the different activities:
  - Task 3, 5, 6, 7 and 9, recording sheet: The use of informal and non-formal science learning. This can be reproduced as an A3 sheet for participants to record responses.
  - Task 6, recording sheet: Characteristics of stimulating outdoor & non-formal learning
  - Task 7, recording sheet: Linking informal & formal learning
  - Task 9, recording sheet: Action plan
- Handouts per group
  - Pictures of non-formal learning environments: suggestions for pictures can be found in the powerpoint Pictures non formal & informal science learning.
  - Pictures of informal learning environments: suggestions for pictures can be found in the powerpoint Pictures non formal & informal science learning.

Linked modules

It might be useful to provide opportunities for participants to become familiar with the definitions of creativity in early years science and key features of inquiry-based approaches to science education prior to the module. For example both:

- Module 4 Focus on inquiry-based science – link with creativity and
- Module 5 Focus on practical investigation which fosters creativity

explore links between inquiry-based and creative approaches to science education.

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