Module 7: Role of play and exploration in inquiry and creativity

Aims of the module:

- Introduce participants to the importance of play and exploration in inquiry based and creative approaches to early years science education.
- Explore the role of the teacher in supporting and extending play and exploration, in order to stimulate creative thinking.
- Engage participants in sharing ideas of how to use this approach in own scientific activities.

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.

7.3 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.

7.4 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.

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.

8.1 Teachers should be able to design and assess open-ended learning activities.

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.

17.2 Teachers should be able to recognize the nature and potential of different materials and resources both to constrain and extend children's explorations.

17.4 Teachers should be able to evaluate provision for free flow play in their school settings.

17.6 Teachers should be able to gain insights into children's developing explorations and creativity based on their use of resources.

Rationale for the module

What is the importance of play and exploration in early year science?

- Playful experimentation and explorations are inherent in all young children's activity. Such exploration is at the core of inquiry based science education and creative approach.
- Bringing more playful approaches into the classroom can support the development of creative skills (Davies et. al., 2013).
- Informal playful experiences nurture children's motivation to understand their world (Larsson and Halldén, 2010), and develop their scientific understanding. The more child-centered, exploratory experiences children have, the higher the chance of

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developing their scientific skills. Providing a variety of different exploratory play resources supports this development (Johnston, 2005).

- Sustained play in early years settings increases children's creativity.
- Open-ended exploratory contexts are well suited to foster learner creativity and learning in science, and to foster more interest and commitment.
- Exploration is a useful tool in developing the skills of observing, raising questions, classifying, hypothesising and communicating (Johnston, 2005)
- Play contexts which prompt children's imaginative engagement enhance their thinking, reasoning and understanding of concepts, but scaffolding by the teacher is required to be effective for learning.

What are the challenges for teachers?

- Children need time and space to explore the world around them in a creative way. Time and space is often limited in a school context. Flexibility in time and space seems to motivate children in their playful activities (Cremin et al., 2006). Children need time to start raising questions for investigation, look for patterns and relationships and offer explanations (Glauert, 2009a).
- In order to promote play and exploration, a rich physical environment is important, alongside the use of the outdoor environment.
- 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.
- There often is too much instruction from the teacher; the teacher offers too much structure. This counteracts play and exploration (Kramer, 2011; Fradd et al., 2001).

Overview of the module

The module consists of the following activities:

1. An **introduction** to the role of play and exploration within inquiry-based and creative approaches to early years science learning.
2. **Exploration of materials**: opportunities for the participants to explore materials.
3. **Discussion of possibilities for play and exploration**
4. **Reflection on the use of the materials:** sharing ideas based on experiences with the materials: focus on a rich physical environment, and the importance of making links with children's everyday lives.
5. Analysis and discussion of the **role of the teacher**: how can a teacher stimulate inquiry and creativity.
6. **Analysis of classroom examples** from Creative Little Scientists: are there opportunities for play and exploration and what factors may provoke this? How does the teacher stimulate play and explorations?
7. **Focus on creativity**: reflection on how approaches might foster creativity.
8. Discussion of possibilities to **apply insights to own classroom practice**: implications for planning and the teacher's role.
9. **Resume** on what has been gained from the module – both content and process, in relation to the aims of the module.

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Module at a glance

Time	Task	Materials	Grouping
00.00	1. **Introduction** to the role of play and exploration within inquiry and creativity, Clarifying that the focus of this module is the role of the teacher in creating opportunities for play and exploration.	Powerpoint presentation • Aims • Links to Content Design Principles and Outcomes • Session rationale - this could be illustrated by examples from the CLS Final Reports (see Support Materials below)	Whole group
00.15	Teachers individually write down what they want to learn during this session and what their questions are. Use of method '5 finger fix'. Participants briefly tell their partner what they wrote down. Facilitator makes a quick list of the little finger digit (= key problems) and questions. This way he gets a clear view on what participants would like to learn and what problems they face.	Pens Task 1 Five finger fix	Individually In pairs
00.25	2. **Exploration of materials** Participants explore the materials and their possibilities. Let participants play with the materials. Possible prompts to make sure participants play and explore: - Can you see your reflection in the different materials? How does it look? - Can you send the light of the flashlight somewhere else? - Can you have the same effect if you use other materials? - … You can leave some materials behind to add when participants find it difficult to keep playing.	Box 'mirrors' or other materials (see Teacher Pedagogy)	Groups of 4/5
00.40	3. **Discussion of possibilities for play and exploration** Participants discuss the previous assignment. • Participants list what they did with the materials. • Participants write down what questions arose during their play. They share ideas of possibilities of play and exploration. *(Materials can remain on the table, so participants can use them for further exploration, if this is relevant for the discussion above)*	Large piece of paper per group White board Pens	Groups of 4/5 Whole group
00.50	4. **Reflection on the use of everyday materials in the classroom** After exploring materials themselves, participants are challenged to step into the	Locally available video of play and exploration or photographs	Groups of 4/5

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	role of children. This phase starts by showing a video clip or some photographs of children exploring and playing with a selection of materials. Participants analyse this video clip or these photographs by answering the following questions. • Note down how these children play, what they explore and research. • Note down questions children ask or might ask themselves while exploring the materials. List these on the white board. Reflection on possibilities of experiencing science. Introduce the list of synergies between inquiry based science education and creative approaches and explain what is considered as play in science: play is linked to exploration, creative thinking and learning about the physical world. If necessary: first explain what 'science in early years' is. • Participants individually list key scientific related activities or use of vocabulary (min. 5), each idea on another post-it. • Discussion with the small group: group the scientific subjects on the sheet of paper. • Let them consider the role of the teacher (linked to the synergies). *Can they see how this science activity is approached in a creative way?* *Can they see which synergies are used to foster scientific inquiry skills and concepts?* • Whole group discussion	of everyday provision for play and exploration (Task 4: Photographs) Paper and pens Recording sheet (Task 4: Reflection on the use of everyday materials) White board Powerpoint slides of definition of creativity in early science and the list of synergies (Task 4: Synergies) (Powerpoint slides of definition of early years science) Post its and pens Blank A3 sheet of paper for groups to share and sort responses Hand-out with overview of the synergies	 Whole group Individually Groups of 4/5 Whole group
1.20	5**. Role of the teacher** How can you foster play, exploration and therefore creativity and inquiry in science and extend the learning of children in this example? • Participants use the questions of children listed in the recording sheet to discuss how they would act on them to foster creativity. • Participants use the key scientific vocabulary listed in the previous assignment to explore how a teacher can foster creativity in these areas. Short discussion in whole group. Take home message: Point out the importance of a **rich physical environment**, the **time and space** they get to explore and the importance of making links with children's **everyday lives** to engage interest and foster curiosity.	Recording sheet Task 4 A3 sheet with scientific key vocabulary from Task 4 Ppt	Groups of 4/5 Whole group
1.40	Coffee break		

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2.00	6. **Analysis of classroom examples** Participants analyse the classroom examples in groups, trying to answer the following questions: • How does the teacher scaffold on the play and exploration to develop the science inquiry of the children? • How does the teacher scaffold on the play and exploration to develop the creativity of the children? • Can you provide other possibilities? Note down key points on the recording sheet provided *(eg adding more resources, questioning, playing along, giving examples, modelling questions and curiosity, observation to be able to scaffold,, …)* Bring it together to discuss the answers and overlap (hopefully there is overlap, because a good scientific inquiry is creative). Brief feedback of general comments related to each question.	Copies of 4 episodes or templates from CLS for example: Selected episodes: BE_Class_TheTipi MA_Class_MeasuringRobots MA_Class_Fruit_Multimodal *For each group* Copies of 2 examples 2 copies of A3 Recording sheet (Task 6 Analysis of classroom example) Flip chart and pens Powerpoint slides of task and examples	Groups 4/5 Work in 2/3 to discuss one example. (If time swap to discuss second example and add to the recording sheet) Feedback with whole group
2.30	7. **Apply insights to own classroom practice** • First individually write down 3 examples of scientific activities you already use in your own classroom context. Then enrich them with ideas to foster more play and exploration in order to provoke creative thinking. Note down possible difficulties and questions you have when transferring this approach to your own classroom context. • Exchange ideas, discuss questions and possible difficulties. Interesting insights are shared with the whole group.	Paper and pens	Individually In groups (4/5) Whole group
2.45	8. **Resume on what has been gained from the module** • Look back at the original questions (five finger fix) – how far have the questions at the start of the module been answered? Facilitator lists key challenges on the flip chart. Participants formulate possible solutions for those issues. • Note 2 actions you will take building on module content record. • In what ways did the different activities support your developing thinking? Fill out evaluation form.	Powerpoint slides of activity and aims Appendix 'Five finger fix' Flip chart Pens, paper Evaluation form	First in groups of 4/5, then the whole group Individually + sharing with the whole group Whole group
3.00	End		

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Teacher education pedagogy

1. **Introduction**

This module draws on 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. Examples of relevant modules and resources you might utilise are provided in the support materials below.

In the beginning of the module the participants write down what they want to learn, what questions they have and a problem they experience, using the '5 finger fix'. The facilitator distributes the appendix with the drawing of a hand. Participants write down on:

- finger 1 and 2: 2 things they want to learn
- finger 3 and 4: 2 things they hope to be answered
- finger 5: 1 problem they have

By using this method teachers write down how they work now. This information will be used in the end of the module, to help participants enrich their current activities to foster more creativity in science.

The facilitator makes a quick list of the key questions and problems. This enables him to focus more explicitly on those matters during the module.

2. **Exploration of materials**

Teachers prefer a hands-on activity to activate their thinking. This approach provides an opportunity to explore the possibilities of simple everyday-life materials.

This hands-on instruction can be done with all kinds of materials:

- Box 'mirrors': mirroring objects like spoons, reflectors, aluminium foil, mirrors of different shapes and sizes, flexible mirrors, shiny stones, fluorescent materials, shiny paper, flashlights, …

or

- Other available materials like a box filled with different kinds of paper, a box with sand and all kinds of materials that can be used to explore the sand like spoons, sieves, magnifying glass, tweezers, small buckets,…

3. **Discussion of possibilities for play and exploration**

This task provides an opportunity to visualize the possibilities for play and explorations, based on the experiences of the participants. By listing these actions, participants gain insights in the richness of simple materials. The materials (from task 2) can remain on the table, so participants can use them during this next task if this helps them to list possible actions. It might provoke new ideas.

4. **Reflection on the use of everyday materials in the classroom**

This part of the module focuses on how children could respond to the materials, what questions they might ask. In this phase the translation is made from own experiences to experiences of the children. This will link to the following part of the module: the role of the teacher when children ask themselves questions while exploring the materials.

This part of the module also focuses on the science in this playful exploration, and the synergies between inquiry based science education and a creative approach. It is often a challenge to see science in everyday life materials, therefore this assignment is of high importance. Teacher often find it difficult to understand how science can be taught in early years, therefore a brief presentation on science in early years can be necessary.

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The use of post-its ensures that all contribute. The sharing and sorting of ideas on a poster helps to clarify the high number of scientific possibilities in everyday life materials. The link to the synergies makes it clear that the science is experienced in a creative way.
The A3 sheet of paper also provides an important reference point for participants when reflecting on the role of the teacher.

5. **Role of the teacher**
The additional layer of analysis in this task (building on recording in task 4) – in asking participants to reflect on the role of the teacher, is important in making connections with creativity and inquiry in science *explicit.* The activity helps participants, not just to become more familiar with creativity in science in early years, but also to consider in more specific terms how they might foster it in the classroom.

In asking participants to reflect on opportunities for creativity it is important to find overall factors that are crucial to provoke creative play and exploration (e.g. time, space, physical environment, materials and resources). This is based on the definition of creativity in early years science developed in the Creative Little Scientists project.

6. **Analysis of classroom examples**
The classroom examples have considerable potential to foster play and exploration. 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 under deliverables D4.3 Country Reports. The recording sheet with the key questions helps focus discussion and provides a basis for sharing analyses with others. It is helpful to note specific comments about the key questions on a flip chart.

7. **Apply insights to own classroom practice**
The aim of this phase of the module is to stimulate teachers to adapt their activities based on the content of the module. By starting this during the module, they can ask questions and point out remaining difficulties. This way, chances are higher that they will try to incorporate this approach in their own classroom practice.

8. **Resume on what has been gained from the module**
The 'five finger fix' produced in task 1, and other recording completed during the session, are designed to provide participants with a starting point for reviewing their discussions and learning across the session and the implications for practice. They encourage consideration of the processes as well as the content of learning to feed into an evaluation of the session.

Support materials

Background reading

Defining key features of inquiry-based approaches and creativity in early years science
This module draws on both the definition of creativity in early years science developed in the Creative Little Scientists project and key features of inquiry -based approaches to science education.
The executive summaries of the Final Reports of the Creative little Scientists project

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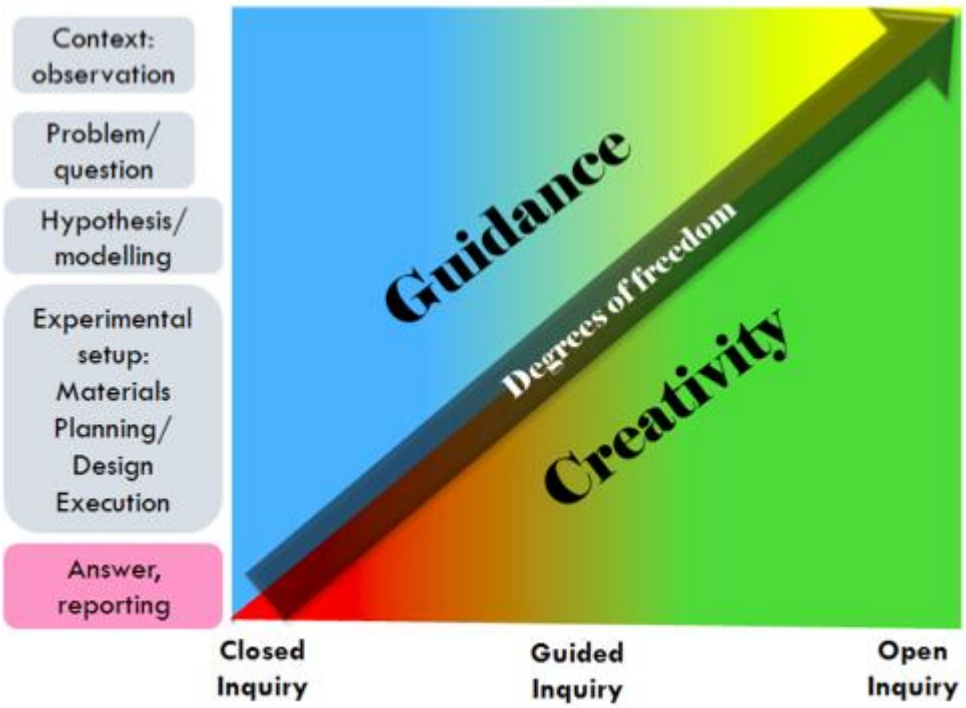
- D6.5 Final Report on Creativity and Science and Mathematics Education for Young Children EXECUTIVE SUMMARY
- D6.6 Recommendations to Policy Makers and Stakeholders on Creativity and Early Years Science EXECUTIVE SUMMARY

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.

Role of the teacher in playful explorations

There is a continuum from teacher-directed on one end to child directed on the other hand, with a shift from closed inquiry to more open inquiry. This implies a balance between guidance (from teachers point of view) to the creativity of the child.
To explain this to participants, the following figure can be very useful (adapted from Fradd et al., 2001).



The model of Barrow can also be used to concretize the effect of the amount of direction from the teacher on the amount of the self-direction of the learner. More self-direction demands a more creative approach from the learner.

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Essential Feature	Variations			
	More.....Amount of Learner Self-Direction.....Less			
	Less.....Amount of Direction from Teacher Material.....More			
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

Essential features of classroom inquiry and their variations
(Barrow, L. H. 2010. Encouraging creativity with scientific inquiry. Creative Education, 1(1),p3.)

Science in early years education

Science is the study of the world and involves exploring and examining theories about the wider world (Johnston, 2014). Early explorations in science are often apparently unsystematic and seemingly unproductive, but as children mature, there is a development of exploratory skills. Exploration plays an important role in the scientific process by helping to develop exploratory skills such as observation, classification, raising questions and hypothesizing. These skills are important first steps in the development of other skills in the scientific process (= exploring → planning → predicting → investigating → interpreting → communicating ↺) (Johnston, 2005).

Role and importance of play and exploration in early years science

The Conceptual Framework (D2.2) for the CLS project, also available on the CLS website at http://www.creative-little-scientists.eu/content/deliverables, identifies *play and exploration* as one of the synergies between creative and inquiry-based approaches to learning and teaching. The full text can be found on pages 47 -49. Some extracts related to this session are shown below.

> Whilst pre-school children differ with regard to their experience of play, exploration and interaction, the significance of play in early learning is widely recognised and represents the focus of considerable research within both approaches. It is argued that **informal playful experiences** nurture children's motivation to understand their world, (Larsson and Halldén, 2010) and Gopnik, Sobel, Schulz and Glymour (2001)

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claim that from as young as two or three, children are able to make causal inferences about information they gain from the environment, demonstrating an ability to reason and reach conclusions, although not necessarily verbally. T**he environment affords significant opportunities for scientific learning through play**, indeed in Reggio Emilia pre-schools, which often involve young children playfully investigating the environment, the power of play is evident (Edwards, Gandini, and Forman, 1993), and research by Garaigordobil and Buerrueco (2011) suggests that sustained play in early years settings increases children's creativity.

In seeking to interrogate the similarities between play and learning in the early years, Samuelsson and Carlsson (2008) comment that "pedagogy should not separate play and learning but draw upon the similarities in order to promote creativity in future generations". They suggest the similarities include: **children's experience as a point of departure, discernment, simultaneity and variation as well as meta-cognition, meta-cognitive dialogues and meta-communications**. A Finnish case study of pre-school teachers, further underscores the idea that play and child-initiated activities characterise the pedagogical work of teachers of this age group (Einarsdottir, 2003). Most scholars appear to perceive that **playful experimentation/exploration is inherent in all young children's activity**, such exploration is at the core of IBSE and CA in the early years. […]

Many empirical studies within the wide field of science, mathematics and creativity research examined in the appended literature reviews, suggest that (apparently1) **open-ended exploratory contexts are well suited to fostering learner creativity and learning in mathematics and science** (Jeffrey, 2004; Burnard et al., 2006; Bonawitz et al., 2011; Cremin et al., 2006; Einarsdottir, 2003; Fawcett and Hay, 2004; Poddiakov, 2011). Supported by the pedagogic space and scope offered for exploration, it appears that children in these studies often extended boundaries and explored with interest and commitment. The young learners' affective engagement in this 'third area', as Winnicott (1974) calls the deep play of childhood, appeared to prompt an openness which their teachers frequently sought to build upon. Such openness, alongside objectivity, is recognised as a critical feature of the development of a scientific stance or attitude (Feng, 1987).

According to Goswami and Bryant (2007) pretend play contexts which **prompt children's imaginative engagement** enhance their thinking, reasoning and understanding of concepts, although they argue that scaffolding by an adult is required if these are to be effective for learning in school. Edo et al. (2009) found that structured sessions and educational visits between free play sessions helped focus the children on the mathematical elements in their role play. In a not dissimilar manner van Oers (2010), notes that parents, in re-interpreting children's verbalisations in play, are able to 'mathematicise' play, capitalising on opportunities for learning mathematics in such contexts.

Several studies which can be seen to involve examination of IBSE and CA, albeit implicitly, demonstrate the importance of providing children with **sufficient time and space to foster such exploration and creative thinking** (e.g. Cremin et al., 2006; Jeffrey, 2005; Martin and Schwartz, 2005). The provision of **'stretchy' time** in the possibility thinking studies encouraged children's immersion in extended playful

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activities and, alongside **the enriched and mutually-owned space**, appeared to motivate and involve the young thinkers (Cremin et al., 2006). In the European Creative Learning and Student's Perspectives (CLASP) project, Jeffrey (2005) also noted that considerable time was afforded to 'open adventures'**,** and that these exploratory opportunities enabled the young **to experiment, push boundaries and take risks**. Additionally, though somewhat differently, Metz(1988) argues that in relation to developing scientific concepts through investigations, over time children improve strategies, and shift in emphasis from making things happen to developing their understanding. This need for time to support exploration is also emphasised by Glauert (2009a), who proposes that over time children "may begin to raise questions for investigation, look for patterns and relationships and offer explanations".

In promoting opportunities for exploration in the early years, research in science, mathematics and creativity also highlights the importance of **a rich physical environment**, use of **the outdoor environment** and the importance of making **links with children's everyday lives** to engage interest and foster curiosity (French 2004). Furthermore provision of a wide range of materials in the classroom can be motivating and offer different ways for young children to represent ideas and express their thinking.

Suggested classroom examples

The following episodes and templates act as useful starting points for discussion.

From the *Creative Little Scientists* project at
http://www.creative-little-scientists.eu/content/deliverables.

BE_Class_TheTipi
MA_Class_MeasuringRobots
MA_Class_Fruit_Multimodal

However it is important to review and select examples appropriate to your context and audience. Other examples can be found on the CLS website
Selected episodes in D4.4 Appendix Selected Episodes of Practice
Templates in D5.3 Addendum to D5.3.

It is interesting to choose activities for different age groups. The opportunities for play and exploration are often considered to be fewer in older age groups. An example like 'Fruit Multimodal' shows a high potential for older children, especially when you highlight the possibilities.

MA_Class_Fruit_Multimodal:

This activity does not provide a lot of opportunity for play and exploration. The teacher asks the children to cut the fruit in half, and to draw what they see. The questions used are very structured and don't leave much room for creativity.
Even for this age (7-8 years old) play and exploration is important to foster creativity in science. This activity has a large potential. By asking 'What can we learn or discover from this fruit?' children are encouraged to explore the fruit in a creative way: they can weigh it, smell it, squeeze it in different ways, scratch it and smell the peel, look up which animals like to eat it, compare an orange with a tangerine,…

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

Title	Age group	Country
Electricity	4-5	England
An icy adventure	3-4	England
Super soup	4-6	Belgium
Water resistance	5-6	Belgium
The rainbow	5-6	Romania
The sounds around us	6-7	Greece

Module resources

The following documents are provided as separate files:

- Powerpoint presentation
- Recording sheets:
  - Task 1: Five finger fix
    This can be reproduced as an A4 sheet for participants to record responses.
  - Task 4: Reflection on the use of everyday materials
    This can be reproduced as an A3 sheet for participants to record responses.
  - Task 6: Analysis of classroom example
    This can be reproduced as an A3 sheet for participants to record responses.
- Handouts
  - Task 4: Photographs of everyday provision for play and exploration
    The photographs can be reproduced on A4 sheets (in colour).
  - Task ‘: Synergies
    This can be reproduced as an A4 sheet.

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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