Module 10: Cross curricular project work

Aims of the module:

- Introduce participants to cross curricular science teaching in the context of inquiry-based and creative approaches to early years science education.
- Assist pre-school and primary school teachers in understanding cross curricular goals and benefits.
- Share with pre-school and primary school teachers strategies in designing cross curricular projects , based on provided modules examples.
- Increase teachers' awareness on different approaches of cross curricular science teaching.

Links to the Content Design Principles and Outcomes

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.

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.

2. Teacher education should provide teachers with skills and competences to carry out practical investigations of science and mathematics in the classroom.

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.

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.

7. 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.

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.

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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.

15. Teacher education should promote teachers' use of group work to support children's inquiry processes and creative learning.

15.1 Teachers should have knowledge of the value of collaboration for inquiry and creative thinking and learning.

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.

15.6 Teachers should be able to use effective strategies for sharing ideas and discussions from different groups.

16. Teacher education should provide teachers with knowledge of approaches to timetabling and organizing cross-curricular project work.

16.1 Teacher should be able to use approaches to cross- thematic, cross-curricular and project work to promote creativity in science and mathematics.

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.

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.

Rationale for the module

What is cross curriculum teaching/ learning?

- According to Dictionary.com, "*cross curricular* denotes or is related to an approach on a topic that includes contributions from several different disciplines and viewpoints" (http://dictionary.reference.com/browse/cross-curricular), or "involving curricula in more than one educational subject" (http://www.oxford dictionaries.com/definition/english/cross-curricular).
- In some instances related to the teaching process, cross curricular is used in an interchanged manner along with interdisciplinary:

  "Interdisciplinary/cross curricular teaching involves a conscious effort to apply knowledge, principles, and/or values to more than one academic discipline simultaneously. The disciplines may be related through a central theme, issue,

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problem, process, topic, or experience (Jacobs, 1989). The organizational structure of interdisciplinary/cross curricular teaching is called a theme, thematic unit, or unit, which is a framework with goals/outcomes that specify what students are expected to learn as a result of the experiences and lessons that are a part of the unit.

Interdisciplinary/cross curricular teaching is often seen as a way to address some of the recurring problems in education, such as fragmentation and isolated skill instruction. It is seen as a way to support goals such as transfer of learning, teaching students to think and reason, and providing a curriculum more relevant to students (Marzano, 1991; Perkins, 1991)."

- In some cases, the process "applying knowledge and skills from one subject (such as math) to understand and perform tasks for another subject (such as science)" is referred to as *fusion*. For students less prepared for more complex learning approaches, this process could be a limitation, distracting them from the main theme. So, care has to be used in promoting such methods, by a previous clarification with students on the way the lesson is being run. (http://study.com/academy/lesson/cross-curricular-teaching-advantages-disadvantages.html)

What are the goals of cross curriculum teaching/ learning?

The major focuses in using cross-curricular teaching and learning have to be to:

- "motivate and encourage pupils' learning in a sympathetic way in conjunction with their **wider life experiences**;
- draw on **similarities** in and between individual subjects (in terms of subject content, pedagogical devices and learning processes) and make these **links explicit** in various ways;
- provide **active and experiential learning** for pupils;
- develop **meaningful co-operation** and collaboration between staff leading to the dual benefits of curriculum and professional development;
- contribute towards a **broad range of teaching and learning opportunities** located within individual subject teaching, across subjects and in relationship to specific external curriculum themes or dimensions;
- promote **pupils' cognitive, personal and social development in an integrated way**;
- allow **teachers** the opportunity to **evaluate and reflect** on their teaching and be imaginative and innovative in their curriculum planning;
- facilitate a **shared vision amongst teachers** and managers through meaningful collaborations at **all levels of curriculum design**."

(http://www. jsavage.org.uk/research/cross-curricular-teaching-and-learning-5-definitions/).

What are the means to develop cross curriculum learning units?

Generally, there are recommended four methods to design and develop cross curricular learning units, to be applied in the classroom (http://712educators.about.com/od/curriculumandlessonplans/tp/Ways-To-Make-Cross-Curricular-Connections-In-Instruction.htm) :

- parallel curriculum integration, when teachers of two different subjects teach the same topics for a different perspective (i.e. a literature teacher and a history teachers teaching the same subject, discussing the subject from their point of view);

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- infusion curriculum integration, case when the same teacher introduce in his/ her lesson plan information form another filed of study (i.e. discussion on sustainability in the context of teaching about renewable resources);
- multidisciplinary curriculum integration, when teachers of different curricular fields are developing a common project (i.e. a project on environment pollution, where science, mathematics, and history teachers can contribute to holistic understanding of a complex problem);
- transdisciplinary curriculum integration, when a group of teachers introduce a topic/subject in an integrated manner (i.e. the discussion on the discovery of the New Continent when history, economics, social sciences can be involved in a integrated approach).

It is obvious that "infusion curriculum integration" is the most suitable way to be applied in early education, as in most cases, the same teacher teaches various subjects, and it is more easy to him/ her to design a lesson including different facets of the subject to be studied. "*Primary school educationalists tend to think of making links between science and other subjects such as mathematics, language and history. This reflects the fact that primary schools usually employ generalist teachers who teach all subjects*." (*Integrating Science Inquiry Across the Curriculum*, Editorial coordinator: Tina Jarvis, The Fibonacci project, http://www.fibonacci-project.eu). Nevertheless, the major obstacles in this approach reside in the limited science subject knowledge of primary school teachers.

Through its conceptual content, cross curricular science teaching could be a fertile environment to nurture creativity in early education, making possible the development of critical thinking to young children.

Which way to go to run cross curriculum science teaching in the classroom?
In planning a cross curricular lesson we have to consider aspects related to:

- content specific, when the same topic is treated in both science and the other subject of study;
- process involved, when the teacher is focused on the skills and processes to be taught;
- methodology used, when similar methods are used in teaching the two subjects.

(Stead, Di., Planning for cross curricular learning, in : *Enhancing Primary Science: Developing Effective Cross-Curricular Link,* De Kelly, Lois & Stead, Di (Eds.), Open University Press, 2013)

Considering the above mentioned approaches and the goals of cross curricular teaching and learning highlighted at the previous question we can say that one the most effective way to implement this science teaching desideratum is through project-based activities. A well structured project diversifies the teaching/ learning opportunities, in relation to real life situations and challenges, providing a complex context for students' cognitive, social and emotional development, with emphases on cooperation and share of opinions, practices and expertise.

What the benefits are of cross curricular science teaching in early year education?

The Fibonacci project findings indicate (*Integrating Science Inquiry Across the Curriculum*, Editorial coordinator: Tina Jarvis, The Fibonacci project, http://www.fibonacci-project.eu):

- "When successful, pupils find learning easier because it is less **disjointed and more relevant**. Consequently the pupils are more motivated. As only one context is used, language demands are related as the same words

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recur. This is particularly important where there are many different languages spoken in the classroom.

- Pupils are enabled to **use similar skills in different subjects with the same context or problem.** They are helped to see that events do not happen in isolation, thus showing the relevance of science ideas and skills in a wider context. **Knowledge in the real world** is not applied in bits and pieces but in an **integrative fashion**. This is increasingly important as modern technology is changing access to information, defying lock-step, sequential, predetermined steps in the learning process (Kysilka, 1998). After all, when pupils find information on the internet it is not usually presented in separate 'school' subjects.
- Pupils are more likely to **develop creativity, critical thinking and problem solving abilities** as they become more familiar with recognizing the **complex demands of problems** requiring knowledge and skills from more than one subject."

Overview of the module

The module consists of the following activities:

1. **Introduction to cross curricular science teaching**: definitions, goals, benefits.
2. **Identifying opportunities for cross curricular connections within scientific inquiry.** Practical activity.
3. **Sharing your vision and classroom experiences** in relation to cross curricular science teaching.
4. **Discussion of classroom examples** – opportunities for cross-curricular connections, links to goals of cross-curricular approaches, role of the teacher
5. **Reflection on classroom examples** - benefits of cross-curricular links, implications
6. **Design of cross curricular science teaching projects** - group brainstorming. Discussion of implications for planning
7. **Reflections on what has been gained from the module** – both content and process, in relation to the aims of the module.

Module at a glance

Time	Task	Materials	Grouping
00.00	**1. Introduction**: aims and rationale for the module. • Introducing definitions of creativity in learning and teaching from the Final report of the Creative Little Scientists project, 2014, adopted by the CEYS project. • Initial expectations - Keep and display record sheets for reference later in the "Reflections" session. • What is meant by cross-curricular teaching and learning? • What the benefits are of cross curricular approaches to science education?	Powerpoint presentation • Aims of the module • Links to Content Design Principles and Outcomes • Comparing IBSE and CA Definitions of creativity Creative dispositions • Session rationale: Defining cross curricular and project-based teaching approach • A4 paper sheets, pencils	Whole group and individually.
00:30	**2. Identifying opportunities for cross curricular**	Powerpoint slides of task.	Groups 3/4

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	connections within scientific inquiry. Practical activity. *In groups of 3/4* - Try out one of the practical activities provided. 1. What is the potential in each activity for: • Making links to everyday life experiences? • Fostering inquiry skills and creative dispositions? • Applying skills and knowledge from other subjects? 2. In what ways can the teacher foster connections? *As a whole group* share experiences Identify aspects of cross curricular opportunities in the context of scientific inquiry.	Choice of practical activities: 1. Can you make a parachute so that a present be delivered safely? 2. Which materials would make the best ear muffs? 3. Which vegetables are suitable for dyeing fabrics? Activity sheets and resources for short practical activities.	Followed by whole group
00:50	**3. Sharing your vision and classroom experiences** in relation to cross curricular science teaching. *As an individual record on separate post its* • 2/3 examples of cross-curricular teaching and learning from your own classroom • What kinds of links across the curriculum were involved? • What was the rationale/inspiration for the design of your examples • Did you receive any support or assistance in designing cross-curricular learning experiences – from whom? • What challenges did you face? *As a group of 3/4* • Share and group your responses on a poster • Any common themes or differences? • What issues does this raise?	Powerpoint slides of task. Post-its Pens	Groups of 3/4.
01:10	**4. Discussion of classroom examples –** opportunities for cross-curricular connections, links to goals of cross-curricular approaches, role of the teacher. • Which goals of cross curricular science teaching are reflected in the following classroom examples? • In what ways do these cross-curricular approaches support children's creativity and inquiry? As an individual - record answers on separate post its. As a group - share and sort responses Any common themes or differences? Whole group - discuss key points, issues for planning	Powerpoint slides of : the task, key details from the selected episodes. Copies of 3 episodes/templates from CLS for example: – Float and sink: Science and Literature – Soft play: Science and Physical Education – Carpenter corner: Science and Mathematics Post-its Pencils	Individual. Groups of 3/4. Whole group.
01:30	Break		
01:30	**5.Reflection on classroom examples** - benefits of cross-curricular links, implications In pairs read through the example. Then consider the following questions: • What are the **potential benefits** of cross curricular science teaching reflected in the	Powerpoint slides of activity. Selected curriculum materials from CEYS: • Crime Scene investigation • Ema and her food	Groups of 2. Whole group.

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	classroom examples? • What is the **role of the teacher** in fostering connections? • In what ways do these cross-curricular approaches **support children's creativity and inquiry**? • What are the **implications for planning**? Whole group - Exchange of ideas and implications for planning	preferences • The sounds around us	
02:00	**6.Design of cross curricular science teaching projects -** group brainstorming. Discussion of implications for planning. • In groups of ¾ design a cross curricular science project. • Make notes in relation to the 'vulnerable spider web' • Build on a theme you already use in your classrooms or consider one of the following themes: Toys, Celebrations, The Home. • Prepare a poster to share • Identify any questions/issues.	Powerpoint slides of the task. *Handout:* The vulnerable spider web (van den Akker 2007 p 39).  A1 sheets of paper for posters Pencils	Groups of 3/4. Whole group.
02:30	7.**Reflections on what has been gained from the module** – both content and process, in relation to the aims of the module. *In groups 2/3s* • Look back at your original ideas about cross-curricular science teaching. Anything you might add or change? Add in any additional comments or issues in another colour. • Note and record 2 actions you will take building on module content. • In what ways did the different activities support your developing thinking? • How far have the aims of the module been met? Complete module evaluation	Powerpoint slides of activity and aims Original recording Pens, post its Flip chart Evaluation form	Groups of 2/3 and individually.
03:00	End		

Teacher education pedagogy

1. Introduction - This module draws on the definition of cross curricular science teaching, its goals and benefits, in the context of inquiry-based teaching and learning and creativity development. At the beginning of the module, the definition of creativity proposed by the CLS project is discussed, as well as the links between Inquiry Based Science Education and Creative Approaches. The participants write down their expectations and any questions related to the module and keep the records for the final session of the module.

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2. Identifying opportunities for cross curricular connections within scientific inquiry. Practical activities are proposed to participants in order to experience the links to everyday life, to understand how the inquiry skills and creative dispositions can be fostered and how the skills and knowledge from other subjects can be applied. Participants receive the activity handouts and work in groups of 3 or 4. Each group tries one activity. Resources are provided in the form of a wide variety of materials: fabrics, cellophane, plastic sheets, tissue paper, strings of different sorts, plasticine, clay, plastic and cardboard boxes, cotton, wire, corks, coffee, parsley, beetroot, spinach, red cabbage, tea, etc. Teachers use the appropriate materials to solve the problem in the practical activity. Discuss the aspects of cross curricular opportunities in the context of scientific inquiry with the whole group.

3. Sharing your vision and classroom experiences in relation to cross curricular science teaching. Teachers are encouraged to discuss examples of cross curricular teaching and learning from their own classroom because sharing experience can help them to appreciate what was the rationale/inspiration for the design of the examples and what kind of links across the curriculum were involved.

4.Discussion of classroom examples – opportunities for cross-curricular connections, links to goals of cross-curricular approaches, role of the teacher. This activity provides useful examples of goals of cross curricular science teaching and how children's creativity and inquiry are supported.
Details can be found in the relevant Country Reports on the CLS website http://www.creative-little-scientists.eu/content/deliverables under deliverables D4.3 Country Reports.
Each teacher read one classroom example and record answers on separate post its and then they share responses in the group. The final discussion with the whole group will be relevant for emphasize the key points.

5.Reflection on classroom examples - benefits of cross-curricular links, implications
In pairs, participants analyze and discuss different approaches to examples of classroom investigations provided as handouts (curriculum materials from CEYS project available at http://www.ceys-project.eu/content/outcomes). The facilitators present a short description of each example in order to make the teachers familiar with the content before they start reading. Participants reflect on the potential benefits of cross curricular science teaching and how it supports children's creativity and inquiry. Participants reflect also on the role of the teacher and how the teacher can stimulate connections. The classroom examples inspire teachers to think about the implications for planning.

6.Design of cross curricular science teaching projects - group brainstorming.
The aim of this activity is to stimulate teachers to think about a cross curricular science project. Each group of 3 or 4 will choose a theme they already use in the classroom or can consider one of the following themes: Toys, Celebrations, The home. Participants will analyse the spider web model (van den Akker 2007 p 39) provided as handout and design the project according to it. Each group prepares a poster and presents it to all participants.

7.Reflections on what has been gained from the module – both content and process, in relation to the aims of the module.
Teachers are encouraged to consider the records they made in the Introduction session and compare the initial ideas about cross curricular science teaching with their conclusions in the

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end of the module and add any additional comments. They record also 2 actions they take building on the module content. Questions are addressed regarding the accomplishment of the aims 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 cross curricular teaching and its role in early years science

This module draws on both the definition of "cross curricular teaching" and key features of inquiry-based approaches to science education developed in the Creative Little Scientists project. You may find it useful to provide opportunities for participants to become familiar with the content of other modules prior to the Cross curricular project work module. For example:

- **Module 4**: *Focus on inquiry-based science – link with creativity*, module highlighting the connection between IBSE and creativity;
- **Module 5**: *Focus on practical investigation which fosters creativity,* module exploring links between the scientific investigation and the creative approaches to science education;
- **Module 6**: *Focus on collaboration and group work*, module of interest as it concerns the importance of group work and collaboration in IBSE.

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

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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.

The Conceptual Framework (D2.2) for the CLS project, also available on the CLS website at http://www.creative-little-scientists.eu/content/deliverables, refers to cross curricular science teaching and learning. The full text can be found on the cited pages. Some extracts related to this subject are reproduced, for reader's convenience, below:

> "In preschool, science knowledge and understanding is often suggested in rather general terms through indicating broad topics to be addressed. Although specific areas of study are not often identified or required in the early years – an emphasis on processes and attitudes predominates. More precise detail is frequently provided in relation to mathematics in the early years. In contrast, in primary education, there is a tendency for greater detail in curriculum content. In some countries, **links between science and other subjects are not only indicated in the way that the curriculum is presented but encouraged in the approaches to science teaching advocated** - for example in preschool in Greece, Belgium, Germany where guidance encourages programmes built around cross-curricular topics and children's interests." (pg. 9)
>
> "Creativity is sometimes referred to as a more independent (reified) entity to be fostered alongside other aspects, e.g. "promote greater flexibility and creativity" (Scotland), "develop curiosity, creativity, critical thinking and interest in the scientific and technical progress" (France) or "mathematical thinking i) creative thinking ii) reflective thinking iii) critical thinking" (Greece). In Wales, the phrase, "activities should foster curiosity and creativity and be interesting, enjoyable, relevant and challenging for the learner" suggests that creativity is something distinct from these other aspects. In England, the previous national curriculum document listed thinking skills (including enquiry skills, creative thinking skills, reasoning skills and evaluation skills); **key skills such as problem solving; and creativity, these were to be applied across the curriculum**. Currently the curriculum is being re-written." (pg. 43)
>
> "The *Creative Little Scientists* project has an underlying premise that creativity is important and relevant to science and mathematics education in the early years. This is not necessarily a common belief. A study of the curricula of 27 EU countries (Heilmann and Korte, 2010) found that the term creativity was found most frequently in subjects like arts and music rather than mathematics and science and was slightly more common in secondary rather than primary curricula. There were mentions of creativity as a **skill, such as creative thinking and creative problem solving, which did apply across subjects**, including mathematics and science." (pg. 100)

Examples of cross curricular science teaching modules

Integrating Science Inquiry Across the Curriculum, Editorial coordinator: Tina Jarvis, The Fibonacci project (http://www.fibonacci-project.eu)

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Examples of Math supporting Biology teaching

The NRICH project (http://nrich.maths.org/frontpage) offers support for teachers willing to teach the use of Math to solve practical problems, starting with activities from lower primary. The site describes several exemplar activities in which Math can be applied in Biology teaching, in activities such as: **bird watch**, terrariums**, food web or counting dolphins (**http://nrich.maths.org/stemnrich**).**

Examples of Math assisting Science teaching

Good examples of learning units developed around the concept of cross curriculum teaching (involving Science and Math), involving comparison and ordering of objects according to specific quantities (length, volume, area, capacity, mass, time, temperature) are available from New Zealand Maths (http://nzmaths.co.nz/ao/gm1-1-order-and-compare-objects-or-events-length-area-volume-and-capacity-weight-mass-turn-angle-).

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: RO Float and Sink, BE Carpenter Corner 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: UKEN Soft play, BE Carpenter corner, RO Float or Sink in Addendum to D5.3 *at* http://www.creative-little-scientists.eu/sites/default/files/Addendum_to_D5.3_with_Index.pdf

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

Title	Age group	Country
Crime Scene investigation	7-8	England
Ema and her food preferences	4-5	Romania
The sounds around us	6-7	Greece
The rainbow	4-5	Romania

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

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- Handouts
  - Task 1: Sheets showing definitions of creativity in early years science and Features of inquiry and creative dispositions - for reference during the session
  - Task 2: Practical activities with list of resources – Make a parachute, Materials for best ear muffs, Vegetables suitable for dyeing fabrics.
  - Task 6: Sheet with the spider web model (van den Akker 2007 p 39)

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