D3.1 GUIDELINES FOR CREATIVITY IN SCIENCE EDUCATION

Guidelines for Creativity in Science Education

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Short Description:

This section of the D3.1 deliverable provides one Implementation Scenario example within the three CREAT-IT Case Studies (Write a Science Opera (WASO), Science Theatre (S&T) and Junior Science Cafes (JSC)).

List of Recipients:

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Table of Contents

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1. Introduction

We present here guidance and a framework to help you develop creative approaches to teaching science for pupils in the 9-14 age range. There is evidence to suggest that using creative teaching approaches and providing an environment in which pupils can think and act creatively improves motivation and progress in learning.

Although the arts are not the only way to engage in creative thinking – they are a powerful source of imaginative and practical ways to engage pupils. Both the arts and sciences are concerned with understanding the world through investigating, experimenting, invention and innovation. Both artists and scientists learn to collaborate, take risks, and need to be able to communicate their ideas to their peers and also to the general public.

In the CREAT-IT Project we have developed a set of 12 Pedagogical Principles for creative science education[1]. These are conceived as providing the basis for thinking about how you can develop your teaching in creative ways and what skills, knowledge and understanding your pupils might develop both in and through working creatively in science.

The principles have been developed from a number of research projects undertaken in both science and arts education; and from a survey of science educators views about creativity in science education, undertaken for this Project (see CREAT-IT Pedagogical Framework (D2.1) and Effective Creative Science Teacher Profile (D2.2) for a more detailed account of the theories, survey and principles.)

1.1 The CREAT-IT Pedagogical Principles

Professional wisdom is respected and encouraged across the CREAT-IT (i.e. it is a context within which the principles function): it is vital that CREAT-IT has at its heart the wealth of teaching and discipline knowledge and expertise that practitioners bring to the project. This is a deeply contextualized knowledge often informed by intuition, which needs to be in constant conversation with CREAT-IT ideas and theories. This principle connects to the survey finding that a creative science teacher is constantly developing and pupil focused: it can be argued that this interrelated development and pupil focus are based in a process informed by professional wisdom.

[1] These were later restructured and provided as 8 Principles. Please see Appendix.

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The 8 Key CREAT-IT principles are (in no particular order):

Individual, collaborative and communal activities for change: practice within CREAT-IT can allow for all three ways of engaging in activities, and particularly in relation to communal engagement can take advantage of the shared identities within which participants will work, allowing for difference but with a shared creative process and purpose. The survey showed collaboration to be a key characteristic of creative science teaching as well as individual and communal learning as a key strategy, thus reinforcing this principle.

Risk, immersion and play: allowing for these three processes to filter across CREAT-IT learning and recognize how pedagogy can assist in creating literal space as well as 'thinking' space for these to occur. This principle is also reinforced by the survey findings, which show risk as being perceived as important to the creative teaching process, and by inference the resulting learning.

Dialogue: practice can allow for dialogues between people, disciplines, creativity and identity, and ideas. This dialogue needs to acknowledge embodiment (i.e. dialogue is not simply a verbal activity) and difference and allow for conflict and irreconcilable difference. It is important to facilitate open discussion of the questions generated by pupils (bottom up) and bring these into dialogue with live questions from professional science and science education (top down).

Interrelationship of different ways of thinking and knowing: CREAT-IT can allow space for multiple different ways of thinking (e.g. problem-finding, problem-solving, exploring, rationalizing, reasoning, reflecting, questioning, experimenting) focused around shared arts/science threads or throughlines. At the arts/science interface it can also offer the space for three different ways of knowing (knowing that - propositional knowledge, knowing how - practical knowledge, knowing this - aesthetic or felt knowledge), as well as acknowledging the embodied alongside the verbal.

Discipline knowledge: understanding the importance of allowing space for the rigorous discipline knowledge of both the sciences and the arts is vital, as well as understanding the importance of materials relevant to those disciplines (e.g. their bodies, with props, with paper and pencil, with sculpting materials, with Bunsen burners and test tubes, with chemicals, with equations) and how creativity might interact with these disciplinary knowledge bases differently, albeit in the context of science education.

Possibilities: – CREAT-IT practice can allow for multiple possibilities both in terms of thinking and spaces, and know when it is appropriate to narrow or broaden these

Ethics and trusteeship: CREAT-IT adult professionals and learners consider the ethics of their creative science processes and products and be guided in their decision-making by what matters to them as a community, acting as 'trustees' of that decision-making and its outcomes.

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Empowerment and agency: through empowering pedagogies, CREAT-IT can allow both learners and adult professionals to gain a greater sense of their own agency and ability to express themselves, and to then know what to do with that in order to be more creative scientists and to develop more creative science teaching techniques. Enabling pupil agency and encouraging children to try out (and critique) their own ideas in investigations were also key factors to emerge from the survey, thus emphasizing the importance of this principle.

Alongside these Pedagogical Principles we have also used the framework developed by science educators for supporting Inquiry Based Science Education (IBSE) a teaching strategy that aims to develop learning by establishing investigations that students participate in to solve a scenario or problem. 'IBSE is seen as an 'Inductive Approach' or 'bottom-up' approach as the pupil is given space to observe and experiment with their knowledge as the teacher guides their learning' (see The CREAT-IT Pedagogical Framework www.creatit-project.eu (D2.1)).

The IBSE Framework proposed by the Cosmos Project (2008)[2] indicates 5 phases or stages in a learning process (this may be part of a lesson or a sequence of lessons / project).

Phase 1 Question eliciting Activities/Exhibiting Curiosity

Phase 2 Active investigation

Phase 3 Creation

Phase 4 Discussion

Phase 5 Reflection

The CREAT-IT project offers ways in which teachers can explore the possibilities of using the arts in a variety of ways to reflect and promote these principles. The arts 'can help to shape and deepen the question on which an inquiry is based, often setting it within a wider moral, ethical context' (Parker, 2011). The arts can suggest new ways of collecting data and presenting the results of an inquiry, such as a photograph collage, song writing, dance, drama or video.

[2] Cosmos (2008) Guided Research Model. Development of an Educational Scenario Template. [online] available from http://www.cosmosportal.eu/cosmos/files/help/COSMOS_Learning_Activities_Templates.pdf [retrieved 5th June 2014]

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In this deliverable you will find guidelines for 3 examples of arts science projects that are currently practiced in Europe. They each offer different ways to involve the arts in science education, and there are at least two ways you might choose to use them:

1. As a dedicated project involving a collaboration of science and arts teachers/ practitioners working through (perhaps) a term and ending with a presentation/ performance.
2. Taking one idea or activity from a project and adapting it your usual teaching.
3. Developing relationships with outside arts professionals to create and deliver a project within the school.

Each project is presented showing how the 12 Pedagogical Principles can be reflected in the learning activities and how the IBSE phases are followed. The IBSE Phases are interdependent as they identify a process so these need to be taken as a whole. However, it is anticipated that, in your own work you may find that certain of the pedagogical principles are more relevant than others – they should provide a stimulus to your thinking when planning and also to reflecting on your teaching.

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2. Write a Science Opera (WASO)

Science unit topic Technology (Norwegian Secondary school curriculum) **Class information** **Year Group:** 8-10 grade **Age range:** 13-15 **Sex: both** **Pupil Ability:** The scenario allows space for pupils of various abilities to participate, e.g. pupils with language difficulties may contribute on an equal level to others by performing in the orchestra.	Materials and Resources *What do you need?* Various music instruments, materials for making costumes. Optional: Stage, lights *Where will the learning take place? On site or off site? In several spaces? (e.g .science laboratory, drama space etc), or one?* Learning can take place in school and\or at science education center or museum. It is a good approach to have several rooms available during the phase where pupils are split into groups (see WASO Guidelines) *Health and Safety implications?* In the case of sewing, it is important to ensure maximum safety by having a qualified teacher available at all times and corresponding instructions. *Technology?* Computer with internet (searching for information), *Teacher support?* Team teaching with both arts and science and arts (music\dance\design\drama) expertise is recommended.

Prior pupil knowledge

No prior knowledge regarding the brain or Artificial Intelligence is required. Pupils can use this scenario in order to explore basic concepts in both fields. If pupils do have prior knowledge about the brain, they will still be able to profit from engaging with the scenario, but they will probably think about it in a deeper way.

Optional: music lessons including composition exercises; basic drama exercises; dance; arts & crafts classes; experience with school stage performances is an advantage

Individual session project objectives *(further details for these sessions are provided below):*

During this scenario, students will:

Week 1): Engage in activities which inspire curiosity around the topic of AI and nervous system; Explore musical, visual design, drama techniques as tools for the opera. *Note: Teachers may decide the science opera's theme before the project or allow pupils to choose the scientific theme themselves. Each approach has its advantages: In the case in which the teacher chooses the theme prior to the project, it will be possible to realize the project during a shorter time-span. On the other hand, pupils may experience greater ownership and agency if they are allowed to choose the opera's theme themselves. In the case of the current scenario, participants in the WASO Summer School chose the scientific theme themselves by generating preliminary ideas and then engaging in a democratic process to finalize their choice of AI and the nervous system. In both cases (teacher choice or pupils' choice) it is important and motivating that the pupils investigate their own questions connected to the chosen theme.*

Week 2): Create specific synopsis, libretto, composition, scenography, costumes for the Science Opera. Continued exploration of scientific topics. *The libretto should include key concepts connected to the scientific theme. Scientific models and figures can be of great inspiration to scenography, costumes and music.*

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Week 3): Finalize and perform a multi-disciplinary artistic performance (school opera) which demonstrates and deepens scientific and emotional understanding of the AI and nervous system learning processes, supporting discipline knowledge in both the science and arts educational disciplines.

Assessment

The WASO Guidelines' Appendix 1 provides an evaluation plan for students who took part in the WASO project. This questionnaire includes questions about their level of enjoyment, level of difficulty, comparisons to more traditional teaching methods, etc.

To record this, questionnaires will be filled out by pupils and collectively delivered to the CREAT-IT team.

Differentiation

How can the activities be adapted to the needs of individual pupils?

Some pupils have had more training in arts disciplines (e.g. music, drama, costume-making). These pupils may be encouraged to do more advanced work. Examples: A pupil who has had piano lessons may be encouraged to compose an extra aria for the Science Opera; a pupil with good stage presence may be asked to assist the other performers in learning how to express the section(s) of the libretto which they will be performing.

The creative process is in itself inclusive of all pupils. The more pupil voices there are with different thoughts and viewpoints (independent of level of understanding) greater the pool of ideas will be with more input to the opera's story.

Key Concepts and Terminology

Science terminology:

1) Technology exemplified by Artificial Intelligence (motherboard; chip; processor…)
2) The brain and emotion (neurons; hormones; synapses…)
3) Exploring basic issues regarding consciousness

Arts terminology:

4) Aria: Solo song by one character. The plot's "action" is stopped to allow this character to express a certain emotion and inner feelings.
5) Duet: Two singers, preferably each singing their own verse followed by a section in which they sing together.
6) Ensembles: Three or more singers
7) Choir: The choir can be used to "comment" during the other songs, or as simple choir pieces.
8) Overture: Instrumental (no voices) opening piece which sets the mood of the opera.
9) Interlude: Music performed between acts or scenes.
10) Recitative: "Spoken Song" which tells a story, and which propels the plot further by revealing action (what has taken place, what will take place, a secret, etc.).
11) Tableau– A dramatic activity in which a group of pupils are asked to physically construct an opera scene through body placement, facial expressions, and props

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Session Objectives:

During this scenario, students will

- Create a multi-disciplinary artistic performance (school opera) which demonstrates and deepens scientific and emotional understanding of the scientific themes, supporting discipline knowledge in both the science and arts educational disciplines.
- Learn basic concepts about the functioning of the brain.
- Learn basic concepts in technology, and specifically Artificial Intelligence and its meaning (technological and ethical) for human emotion.

IBSE Activity	Potential arts activity	Student	Teacher	CREAT-IT Pedagogical Principles
Phase 1: Question Eliciting Activities	Begin cooperation with artists or the music/fine arts/drama/dance teacher at your school in order to generate ideas Discuss with your students the idea of creating a multi-disciplinary performance designed and inspired by a scientific theme. Define opera's theme based on scientific Question current knowledge	Generate and write down words\ideas about Artificial Intelligence (AI) and the human mind, and shares with others in order to learn from their previous knowledge	Activates previous knowledge in the fields of Artificial Intelligence (AI) and the human mind, and motivates pupils to raise questions they are wondering about based on these.	*Professional wisdom is respected and encouraged*: It is vital that CREAT-It has, at its heart, the wealth of teaching and discipline knowledge and expertise that practitioners bring to the project. CREAT-IT Pedagogical principles relevant to the lesson: 1. Individual, collaborative and communal activities for change 2. Risk, immersion and play 3. Dialogue 4. Interrelationship of different ways of thinking and knowing 5. Discipline knowledge 6. Possibilities 7. Ethics and trusteeship 8. Empowerment and agency

Lifelong Learning Programme

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Phase 2:	**Active Investigation**	Propose opera characters representing various entities in the learning process (e.g. Cyborgs, technologists, human characters which interact emotionally), etc. Divide students into groups (orchestra/composers, librettists, stage design, opera chief, Public Relations, etc.). Explore representing the chosen scientific learning theme as a dramatic storyline.	Explores the preliminary questions proposed by the students, defines ones to work with, and collects information aimed at responding	Leads a discussion based on the following questions: What do you want to find out about these questions? What are your predictions regarding these?
Phase 3:	**Creation**	Main activity of opera creation and rehearsals, on all levels (costumes, music, staging, libretto, etc.). *Teacher's Tip: Sources of inspiration may include the actual equipment being used*	Propose definitions and examples of potential science operas. Explore various examples of expressing scientific concepts through the arts. Social media: Students may document their investigation with video and photos to share on websites to open up further debate and feedback, they utilize these comments in their reflection	Leads a discussion based on the following questions: What is a science opera? How can you represent scientific concepts through arts? What do you observe in the way your knowledge is learned? What are the scientific key concepts in AI and nervous system? Teacher defines central key concepts to be included in the process: What do you expect to learn about the scientific themes? How would you explain the way you are learning? What is expected/ unexpected in this way of learning? Can you think of a different /interesting way to approach this way of learning besides opera?

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Phase 4: Discussion	Discussion of any challenges that arise as part of the working process. ("Which concepts should be included in the libretto?" "What is the main difference between human and artificial communication? And how can we visualize that?"). Therefore the discussion and creation phase will necessarily be entangled.	Prepare their results for discussion. Perform the Science Opera. Possible use of social media: Share video of discussion on Youtube to open up further discussion within the community; Conduct the discussion with video / audio conferencing; Post images of the work taken on Instagram; Twitter for comment; Present results online using Prezzie or Glogster.	Helps students evaluate results. Leads a discussion about how to produce different elements exposing the different science themes, and which science elements should be included. Asks the following questions: What is the relationship between Artificial Intelligence and the human brain with respect to emotion? Which are these the point about AI that we want to communicate? What information would you use to support your view? What remains unclear?
Phase 5: Reflection	Discuss various specific and focused issues (stage design, libretto, PR activity, group dialogue, ethical decision-making regarding inclusion of all students in the creative process, etc.).	Upload results (recordings, assessment) to the CREAT-IT portal (portal.creatit-project.eu) Students write a blog post sharing their reflection with others in the community for feedback and further debate. This should include themes defined in the learning objectives. Students prepare an online self-refection presentation using Prezzie, Glogster, Scoopit.	Creates an overview of what has been discussed in the classroom during the project. You may focus on challenges which arose during the process or why various images were chosen as activity foci. Discuss balancing a 'bottom-up' and 'top-down' approach. Teacher leads a discussion including the following IBSE questions: Has your thinking changed through exploring AI and the nervous system by working in this way? What new question could you ask? The teacher guides the student to further open-ended study. The teacher can engage students in reflecting on the resemblances and differences of creating art and science.

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3. Science Theatre (S&T)

Science unit topic	Materials and Resources
The history and evolution of the universe and life **Class information** **Year Group:** 1st-6th grade of Greek high school **Age range:** 12-18 years old **Sex:** both **Pupil Ability:** The scenario allows space for pupils of various abilities to participate, e.g. pupils with language difficulties may contribute on an equal level to others by performing as actors, musicians or dancers, designing the sets/costumes, and participating in the video production.	*What do you need?* Musical instruments, materials for making sets and costumes. Optional: Stage lights and sound equipment. *Where will the learning take place? On site or off site? In several spaces? (e.g. science laboratory, drama space etc), or one?* Learning can take place in school (regular class or music room). It is a good approach to have several rooms available during the phase where pupils are split into groups with different roles for each group. *Health and Safety implications?* In the case of sewing of costumes, it is important to ensure maximum safety by having a teacher available at all times and corresponding instructions. *Technology?* Computer with word processor (for script writing), internet (to search for information), camera (to record the performance). Optional: video editing software (for video production) *Teacher support?* It is advised for teachers of both the Arts and Sciences to be involved. Professional expertise (music\dance\design\drama) will be provided, as well as training workshops for the participating teachers.

Prior pupil knowledge

Some basic knowledge of Biology, Physics, Geology and Astronomy is required. The implementation of this scenario is very flexible, since the teachers and the students will choose the topic they want to focus on depending on their interests and depth of knowledge. They can adapt the script according to the grade level. Pupils can use this scenario in order to understand basic concepts or explore specific topics of interest in greater depth.

Optional: music lessons including composition exercises; basic drama exercises; dance; arts & crafts classes; experience with school stage performances is an advantage

Individual session project objectives *(What do you want pupils to know and understand by the end of the lesson?). Note: A detailed plan for these sessions are provided below.*

Weeks 1-4: Students will become acquainted with the concept of learning science creatively through Science Theater. They should be aware of what science theater is and how it will help them deepen their science knowledge and express themselves creatively. They should also be specific about key concepts they will be focusing on.

Weeks 5-18: Students will gain knowledge and experience with group-work in which various groups will create a script, scenography, costumes, music and a video composition. The script should include key concepts connected to the scientific theme. Scientific models and figures can be of great inspiration to scenography, costumes and music.

Weeks 19-20: The students should be able to describe fundamental concepts concerning their chosen topic**.** Students will learn to realize common impulses between discipline knowledge in both science and arts by performing a multi-disciplinary artistic performance which demonstrates and deepens scientific and emotional understanding. Throughout the scenario, pupils will learn

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to make their own decisions during inquiry processes, make their own connections between questions, planning and evaluating evidence, and reflect on outcomes.

Assessment	Differentiation	Key Concepts and Terminology
Participating pupils will be provided with a questionnaire that includes questions about their level of enjoyment, the scenario's level of difficulty, comparisons to more traditional teaching methods, etc. *How will you record this*? Questionnaires will be filled out by pupils and collectively delivered to the CREAT-IT team.	*How can the activities be adapted to the needs of individual pupils?* Some pupils have had more training in arts disciplines (e.g. music, drama, costume-making). These pupils may be encouraged to do more advanced work. For example: A pupil who has had piano lessons may be encouraged to compose an original score. The creative process is in itself inclusive of all pupils. The more pupil voices there are with different thoughts and viewpoints (independent of level of understanding), the greater the pool of ideas will be, resulting in more input to the story.	**Science terminology:** Big bang, universe, planets, fundamental particles, Higgs particle, chemical elements, solar system, prokaryotic cell (cell membrane, cytoplasm, pyrenoid), cyanobacteria, photosynthesis, eukaryotic cell (organelles, nucleus, endoplasmic reticulum, mitochondria, DNA, mRNA, tRNA), multicellular organisms, *Ichthyostega,* amphibian, mammals, nocturnal, asteroids, *Homo habilis, Homo erectus, Homo neaderthalensis, Homo sapiens*, bottleneck effect. **Arts terminology:** Acting, staging, costumes, synopsis, dramaturgy, dramatic characters, musical composition, musical performance, musical dynamics

Session Objectives:

During this scenario, students will

- Create a multi-disciplinary artistic performance (Science Theater) which demonstrates and deepens understanding, supporting discipline knowledge in both the science and arts educational disciplines.
- Learn basic concepts about the universe and life.

IBSE Activity	Potential arts activity	Student	Teacher	8 CREAT-IT Pedagogical Principles
Phase 1: **Question Eliciting Activities** **(Week 1)**	*Optional:* *Preparatory drama, visual arts and music workshops|classes*	Read the various script outlines. Decide to focus on a topic/topics. Generate and share ideas with others.	Activate previous knowledge in the fields of scientific exploration, and motivate pupils to raise questions. Discuss the idea of creating a multi-disciplinary performance designed and inspired by a scientific theme. Present an outline of the five topics and help pupils choose one or more,	*Professional wisdom is respected and encouraged*: It is vital that CREAT-It has, at its heart, the wealth of teaching and discipline knowledge and expertise that practitioners bring to the project. CREAT-IT Pedagogical principles relevant to the lesson: 1. Individual, collaborative and communal activities for change 2. Risk, immersion and play 3. Dialogue

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			depending on the number of students and preparation time available.	4. Interrelationship of different ways of thinking and knowing 5. Discipline knowledge 6. Possibilities 7. Ethics and trusteeship 8. Empowerment and agency
Phase 2: **Active Investigation** **(Weeks 2-4)**	Script/directing group Investigate characters and generate ideas for dialogues/actions. Actor group Investigate characters and work on performance in collaboration with script/directing group. Music group Generate musical ideas which correspond to the script. Dance group After consulting with script/directing, actor and music groups, generate choreography ideas to incorporate in the play. Set/costumes group Generate ideas after consulting script group and collect materials. Video group Generate ideas after consulting script group and collect or create video clips.	Investigate concepts presented in the script outline and recall previous knowledge. Formulate new questions, do research to answer them and express findings through creative methods (performance, music, dance, etc.)	Divide students into workgroups and present a timeline of the work they will be expected to do during the project. Should they decide to prepare more than one act, the actor group will be further divided into subgroups that will work separately on each act. Lead a discussion asking "What is science theater? How can you represent scientific concepts through art? , What do you want to find out about this topic? , What are the key concepts?"	
Phase 3: **Creation** **(Weeks 5-18)**	Rehearsals on all levels (costumes, music, staging, performances, etc.). Final performance of play.	The video group will promote the project and final performance online. 1-2 pupils will film the performance.	Define central key concepts to be included in the process. Overlook and give feedback during rehearsals. Overlook set and costume creating processes for safety reasons.	

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			Ensure videos used are properly licensed.	
Phase 4: Discussion		Discuss learnings around the scientific topic explored as well as the creative methods used.	Help students evaluate results. Lead a discussion around the topics explored to establish learnings and identify points that remain unclear. Invite students to reflect on the resemblances and differences of creating art and science.	
Phase 5: Reflection (Weeks 19-20)	Discuss specific issues (stage design, music composition, group dialogue, ethical decision-making regarding inclusion of all students in the creative process, etc.).	Upload results (filmed excerpts, assessment) on the school's website, YouTube and Facebook pages as well as the CREAT-IT portal with the help of the teacher. Fill in evaluation questionnaire.	Create an overview of what has been discussed in the classroom during the project. Lead a discussion including the following IBSE questions: Has your thinking changed by working in this way? What new questions could you ask?	

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4. Junior Science Cafe (JSC)

Science unit topic: Biology

(Greek Secondary School curriculum)

Class information

Year Group: 3rd grade

Age range: 13-14 y.o.

Sex: both

Pupil Ability: -

Materials and Resources

What do you need? A microphone for the invited speaker. A camera to film the event and post-event interviews. Printed questionnaires.

Where will the learning take place? On site or off site? In several spaces? (e.g. science laboratory, drama space etc), or one? The preparatory activities will take place in the classroom and during the pupils' own study time. The actual event will take place in a large classroom or school theater so other pupils outside the project can also attend.

Health and Safety implications? None

Technology? Computer with internet access.

Teacher support? None

Prior pupil knowledge

Pupils will have learnt about the meaning of species and populations (Chapter 1). Pupils will be aware of basic principles of evolutionary theory and the evolution of mankind (Chapter 7).

Individual session project objectives *(What do you want pupils to know and understand by the end of the lesson?)*

During this scenario, students will

Weeks 1-2: Be attracted to engage with topics of evolution. Ideally they should feel challenged by questions about the evolution and biodiversity of life.

Week 3: Be familiar with the concept of a Junior Science Café.

Weeks 4-8: Have a deeper understanding of the topics examined and come up with further questions. In specific, be aware of the data that support the theory of evolution, understand how evolution functions through natural selection based on the variability and adaptability of organisms, as well as the timescale. Be able to explain how species are born and become extinct. Perceive human communication as a beneficial trait for the evolution of the species.

Week 9: By asking the scientist questions and actively engaging they will acquire a deeper understanding of the topics and come up with further questions. They will also be more aware of what it's like to work as a scientist.

Week 10: Think of how they would improve the event.

Week 11: Know how to upload material (project outcomes) on the web.

Assessment

Pupils will be asked to write group reports on how the event helped them understand their topics and the theory of evolution in general.

They will also be given a

Differentiation

How can the activities be adapted to the needs of individual pupils?

The project provides a variety of opportunities for each pupil to practice their own talents. All of the students will be required to participate in the investigation

Key Concepts and Terminology

Science terminology:

Natural selection, trait, variability, adaptability, speciation, extinction, geological time, artificial selection, human evolution, fossils

Arts terminology:

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questionnaire to be filled in individually in class. This questionnaire will include questions about their level of enjoyment, level of difficulty and comparisons to more traditional teaching methods.	phase equally. However, they can be involved in varying degrees in the organizational aspects for the event, the interaction with the scientist, the social media coverage, the post-event interviews, article writing for the school newspaper and final report writing.	

Session Objectives:
During this scenario, students will

- Prepare for and organize a Junior Science Café event, while using tools of inquiry-based learning.
- Deepen their understanding of the theory of evolution.

IBSE Activity	Potential arts activity	Student	Teacher	8 CREAT-IT Pedagogical Principles
Phase 1: **Question Eliciting Activities** Weeks 1-2 (1 teaching hour per week) (1-2 hours individual homework to respond to challenges)		Engage with teacher's questions. Watch videos and use the web to explore evolution.	Will use challenging questions and the web (images, videos) to attract the students' interest in the theory of evolution. Could give challenges to students in Week 1 to be answered and discussed in Week 2 (e.g. giraffe's long neck, Darwin's finches etc). At the end of week 2 they will announce to the students the Science Café project and ask them to note down anything they find exciting, inspiring or challenging about evolution.	*Professional wisdom is respected and encouraged*: It is vital that CREAT-It has, at its heart, the wealth of teaching and discipline knowledge and expertise that practitioners bring to the project. CREAT-IT Pedagogical principles relevant to the lesson: 1. Individual, collaborative and communal activities for change 2. Risk, immersion and play 3. Dialogue 4. Interrelationship of different ways of thinking and knowing 5. Discipline knowledge 6. Possibilities 7. Ethics and trusteeship 8. Empowerment and agency
Phase 2: **Active Investigation** Weeks 3-8 (1 teaching hour per week)		Will be expected to contribute in the research of their group's topic and prepare a presentation of the findings. Will be encouraged to include engaging aspects in their presentations such as videos and animations from the web.	In Week 3 the teacher will ask the pupils to split in groups of four and will give them a choice of different evolutionary topics for each group. Some of these could include fossils, common traits of living things, artificial selection, the future of evolution, human skin color, speciation and extinction, the impact of communication on human evolution, insecticide resistance: evolution in fast-forward.	

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(5 hours group homework to collect material) (2 hours group homework to prepare presentations)		They will also be asked to find local researchers in the field.	The teacher can suggest sources (both printed and online) where the pupils will find relevant information. During the presentations the teacher will promote discussion and deeper understanding by posing relevant questions.	
Phase 3: **Creation** Weeks 4-8 (1 teaching hour per week**)**		Students will collect questions emerging out of their research. It is advised for each group to collect four questions and rate them according to importance. One pupil from each group will commit to making the list and asking the questions during the event. One pupil will commit to contacting potential scientists and getting the headmaster's permission to use the room. One student will commit to facilitating the event.	The teacher will overlook the question-choosing procedure and provide further advice if needed. They will also be available to help students contacting experts, booking a space etc.	
Phase 4: **Discussion** Week 9 (3 teaching hours)		One student from each group will pose the set questions to the scientist in an order of importance. It will be the facilitator's responsibility to ensure questions from all groups are asked. They could keep track be having a list of all questions per group and ruling them out. All pupils will be encouraged to ask any	Overlook the event, film it and intervene only if required. Upload the video of the event on the school's YouTube page.	

Lifelong Learning Programme

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		other questions that come to mind and engage in a discussion with the scientist, especially in matters concerning the nature of their work, their career route and their everyday work activities. One student from each group will tweet about exciting things that emerge during the event. One pupil will interview the scientist, pupils who participated in the project as well as other pupils who only attended the event. The interviews will be filmed by another pupil.		
Phase 5: **Reflection** Week s 10-11 (1 teaching hour per week) (2 hours group homework for report writing) (1-2 hours individual homework for the pupils that will write the articles)		On Week 10 they will discuss event and suggestions for improvement (Week 10). They will be given evaluation questionnaires to fill in in class. One pupil from each group will write a short article for the school newspaper. One pupil from each group will write the report after consulting with their fellow group members and re-watching the filmed event if necessary. On Week 11 they will hand in the report and articles and upload project materials (filmed interviews, reports, articles) on the web (school website, FB page, CREATIT portal).	On Week 10 they will discuss the event in class, give out and collect questionnaires and instruct the groups to write reports until the following week. The reports will require discussing the pupils' experience in terms of the scientific discipline (what they learnt, further questions). They will also instruct one pupil from each group to write by the following week a short article about the science café that will be published in the school newspaper and online. On Week 11 they will help the pupils upload project material on the web.	

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5. Reference List

Parker D. (2011) Creativity Culture and Education proposed approach to science and creativity education, http://www.creativitycultureeducation.org/

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