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DAYLIGHTING RIVERS
SCIENCE EDUCATION FOR CIVIC ECOLOGY

Daylighting Rivers - European project for innovative teaching

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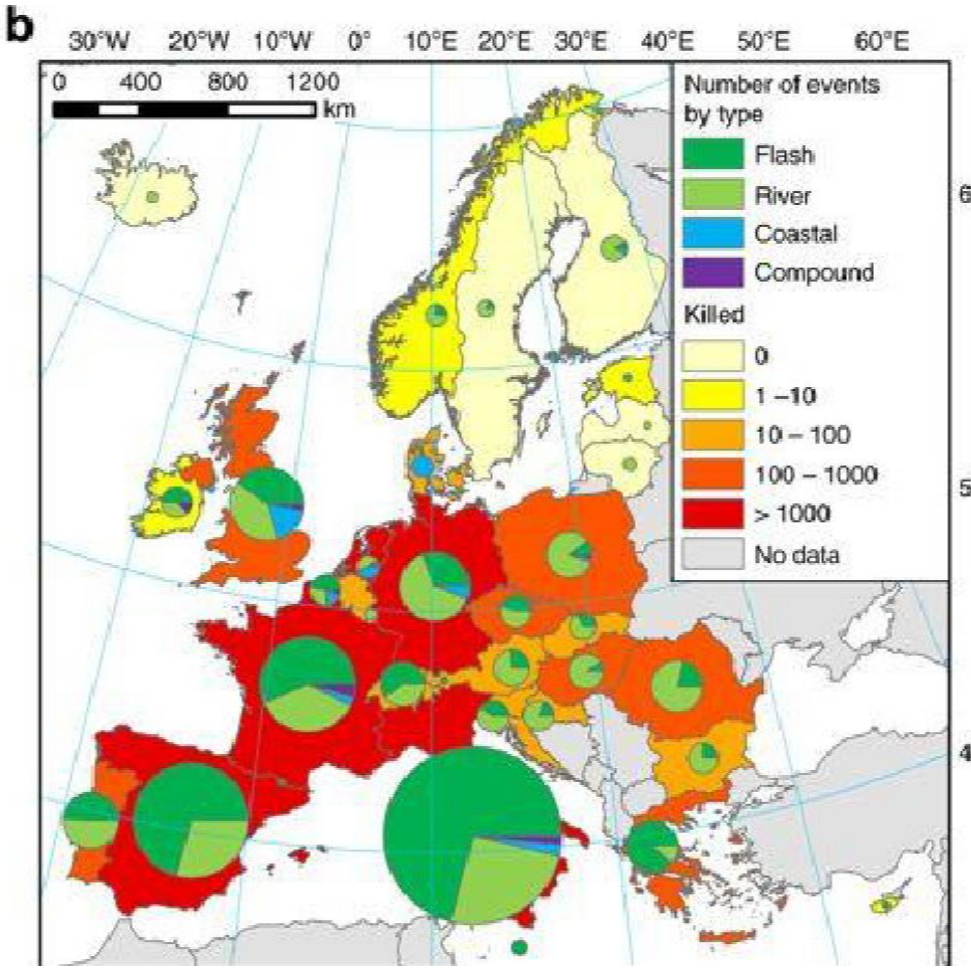
The context

Human land exploitation and modern urban planning choices have affected river flows: rivers have sometimes been exploited to the point of being reduced to minor streams, and in some cases no longer even flow to the sea.

Urban development has too often deteriorated the quality of the water, channeled rivers in lifeless canals and underground culverts, or in some cases eliminated them altogether to make room for other infrastructures. In addition, in the last decades, extreme events such as extremely dry conditions or heavy rains have been increasingly recorded, especially in the Mediterranean basin.

Heavy rains suddenly increase the river flow with consequent enormous hydraulic risks.



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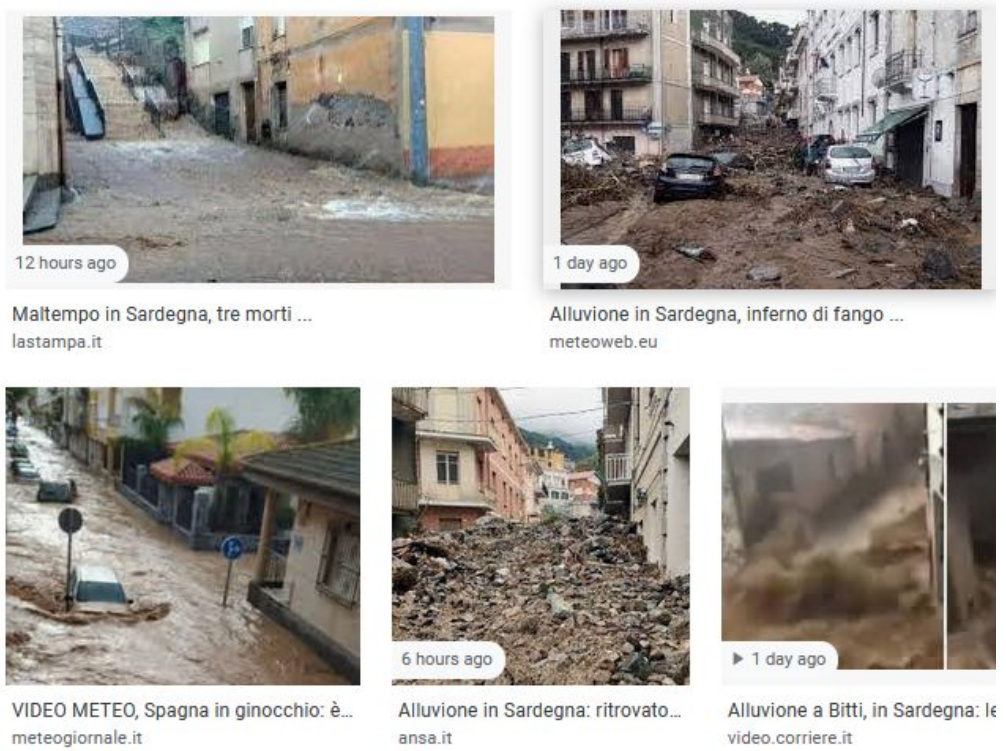
The context

Italy, Greece and Spain present common traits due to similar environmental variables such as climate, vegetation and landforms, and also similar land use and urbanization approaches and impacts.

All these issues have raised the importance of public awareness at all levels of society, regarding the causes of environmental degradation and the need to acquire a more sustainable lifestyle.

Civic ecology can be of aid in raising such awareness, and the integration of these issues into the educational curriculum of the younger generation is crucial.



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Educational aims of the project

The main objectives of DAYLIGHTING RIVERS are:

- To increase the awareness, confidence and understanding of phenomena using the scientific method;
- To enhance the educational experience by making science connected to students' local territory;
- To support multidisciplinary learning involving scientific subjects but also art and history;
- To develop skills in practical activities and technologies;
- To develop soft skills like group work and communication

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Partners

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ICASE
International Council of Associations for Science Education

WATER RIGHT FOUNDATION
WATER ENERGY FOOD HEALTH

Consiglio Nazionale delle Ricerche
Istituto per la BioEconomia

CEBAS-CSIC
Centro de Edafología y Biología Aplicada del Segura

Liceo Scientifico "Nicola Sensale"
Nocera Inferiore (Sa)

PRISMA

Google Earth

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Partnership value

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The partnership includes scientific institutions, professional companies and schools. This has produced a significant benefits for the whole membership:

- Teachers could benefit in terms of:
  - ➔ knowledge transfer and understanding of real-world and new scientific discoveries;
  - ➔ opinion exchange;
  - ➔ access to resources (papers, presentations, didactic materials, scientific instruments etc.)

- Scientists and professionals could benefit in terms of:
  - ➢ Promoting own expertise;
  - ➢ Increasing motivation and enthusiasm in their job;
  - ➢ understanding better the community's awareness and perceptions of science, scientists and their work

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Partnership value

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In addition, students could benefit in terms of:

- acquired knowledge and understanding of research and applications for problem solving;
- had opportunities to experience real science;
- increase awareness of the types and variety of science and technological careers.

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Project pillars

- Effective learning methodology (Inquiry Based Learning) to increase students' interest in STEM
- The promotion of technologies – learning how to use software and devices - is useful for acquiring knowledge and skills based on logical thinking, and for communicating independent findings in a different way.
- Location Based Games to facilitate outdoor end experiential learning but also storytelling and creativity
- The evaluation of the success and efficacy of the project through a set of evaluation tools to test the students' interests regarding the themes of the project, attitude towards STEM and career decision capacity.

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Project development

IO1 Survey on Interest of students and teachers

IO2 Learning methodology

IO3 Development of learning units

C1 5-day training course for teachers

IO4 Piloting with the schools

IO5 Assessment of students' attitude

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International competition

SCHOOLS IN ACTION FOR DAYLIGHTING RIVERS

Winners will be announced at the Prize Award Ceremony

December 2, 2020 - 14:30-17:00 CET

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- The teachers of the piloting schools attended the **Training course (C1) of Daylighting rivers project with focus on the methodology, and fundamentals of Geographic Information Systems (QGIS) and Location Based Games**
  (Florence, October, 2-6 2018)
- 200 students, 20 teachers have been involved in the piloting phase
- The efficacy of the project has been assessed and results will be presented in the next presentation.

Liceo Scientifico "Nicola Sensale"
Nocera Inferiore (Sa)

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Project methodology - introduction

- It is largely acknowledged that students learn better when they can make connections to their own personal experience and knowledge, and draw on these connections through practical activity.

- A number of methodologies (e.g. Inquiry Based Learning) generally follow such belief and the common implementation process is made up of a series of steps: i) defining a problem, ii) formulating a hypothesis or question and iii) conducting tests to verify the hypothesis or answer the question, just as scientists do

- Soft skills deserve attention, the project fosters creativity, communication skills, group work, technological skills

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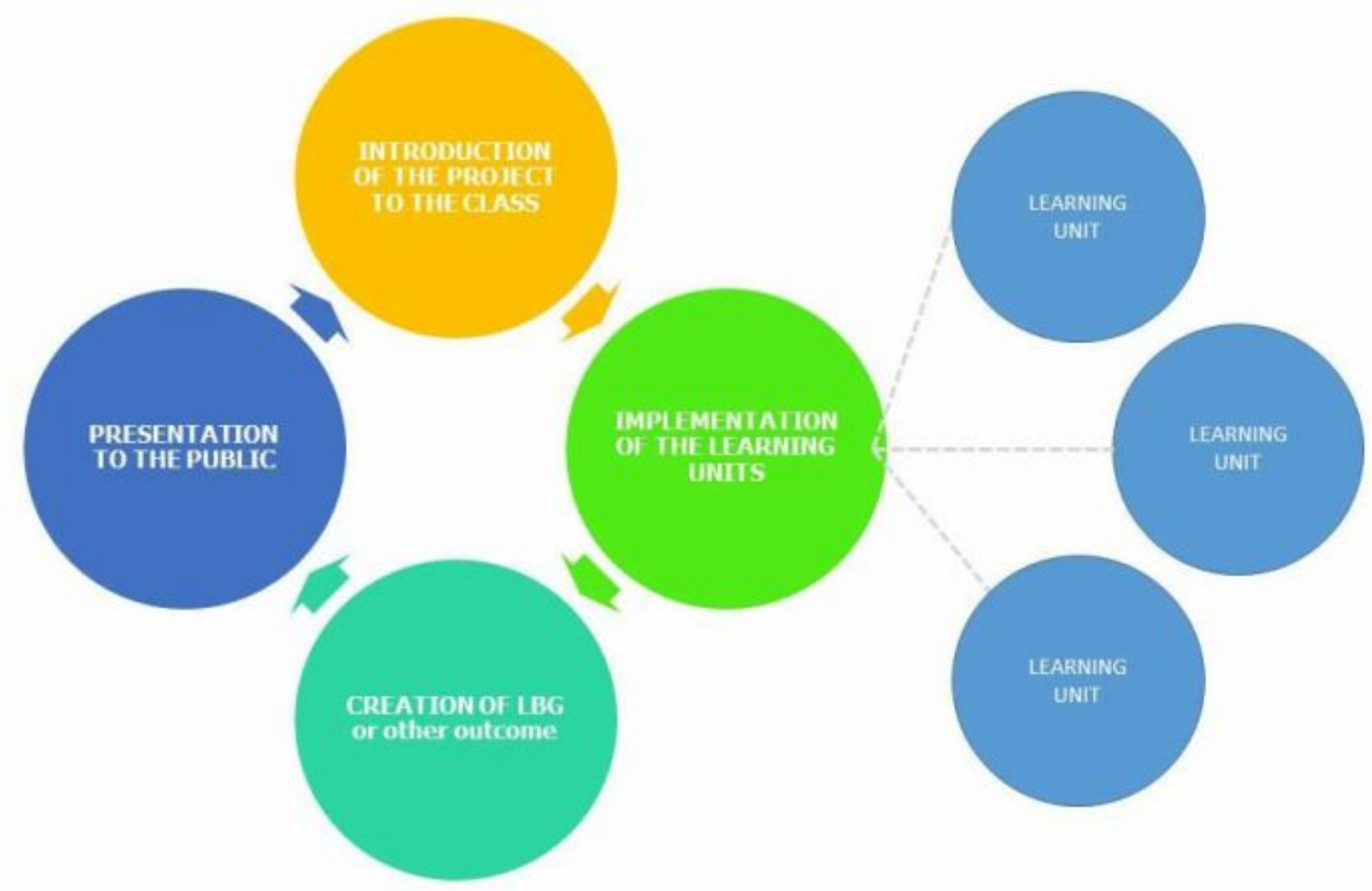
Project methodology



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How to implement a Daylighting Rivers project

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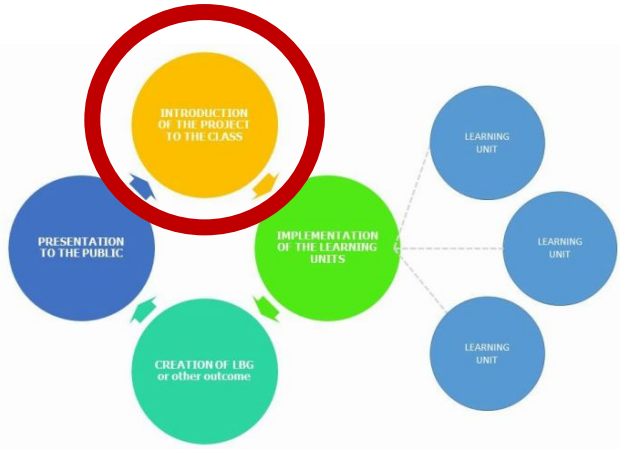

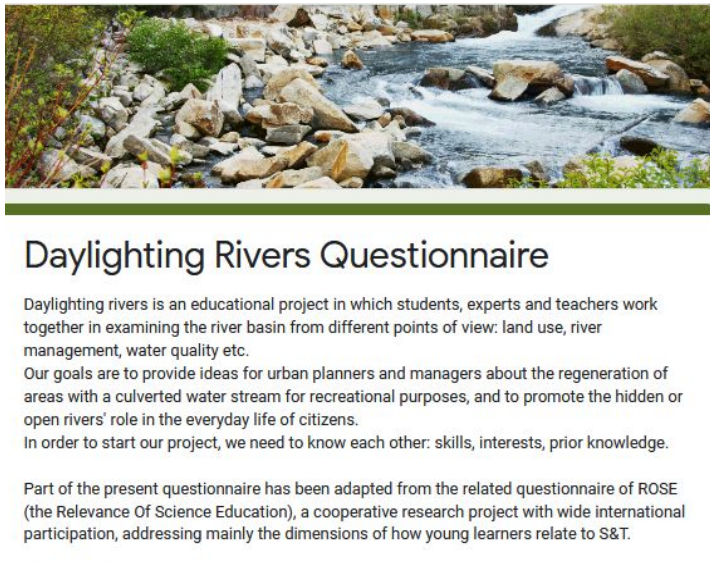

Daylighting Rivers Questionnaire

Daylighting rivers is an educational project in which students, experts and teachers work together in examining the river basin from different points of view: land use, river management, water quality etc.
Our goals are to provide ideas for urban planners and managers about the regeneration of areas with a culverted water stream for recreational purposes, and to promote the hidden or open rivers' role in the everyday life of citizens.
In order to start our project, we need to know each other: skills, interests, prior knowledge.

Part of the present questionnaire has been adapted from the related questionnaire of ROSE (the Relevance Of Science Education), a cooperative research project with wide international participation, addressing mainly the dimensions of how young learners relate to S&T.

1) INTRODUCTION OF THE PROJECT TO THE CLASS

1.1 WHAT DO WE KNOW, WHAT WE WOULD LIKE TO KNOW

At the beginning, it is useful to know the initial interests and base knowledge of the "actors"; and also, we might be interested to know how effective are the learning process and teaching with our methodology and materials.

By using our PRE- and POST- questionnaires https://www.daylightingrivers.com/evaluation/ for the evaluation of the project implementation, we can assess:

- **initial** (and final) **students' and teachers' interests and competences** regarding the themes of the project; but also students' **attitudes toward STEM and career-decision making**; **and teachers' teaching efficacy** by using our tools.

https://www.daylightingrivers.com/implementation/

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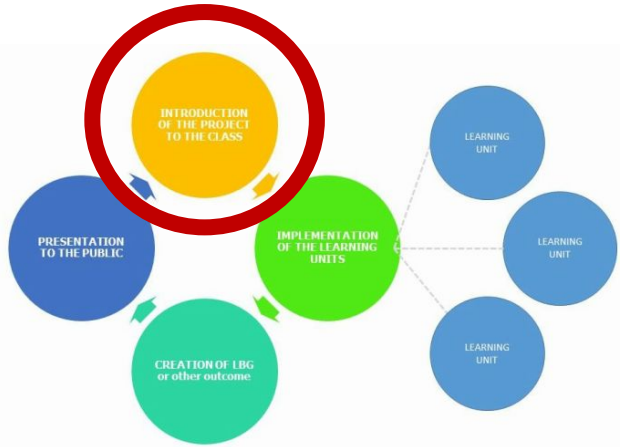
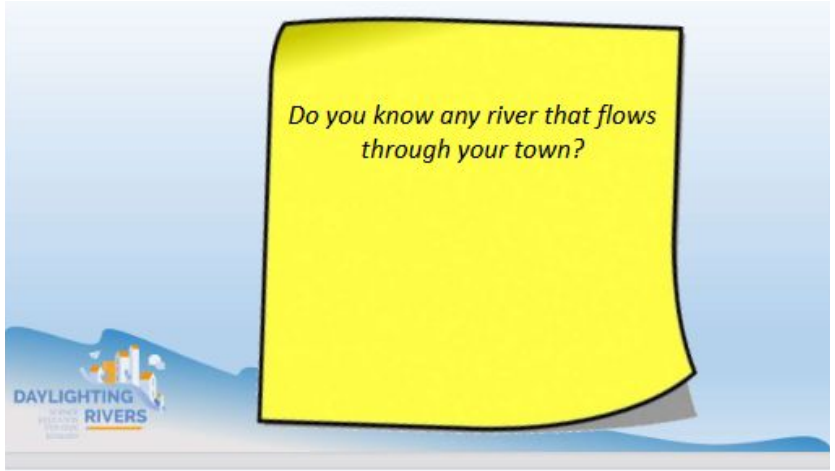


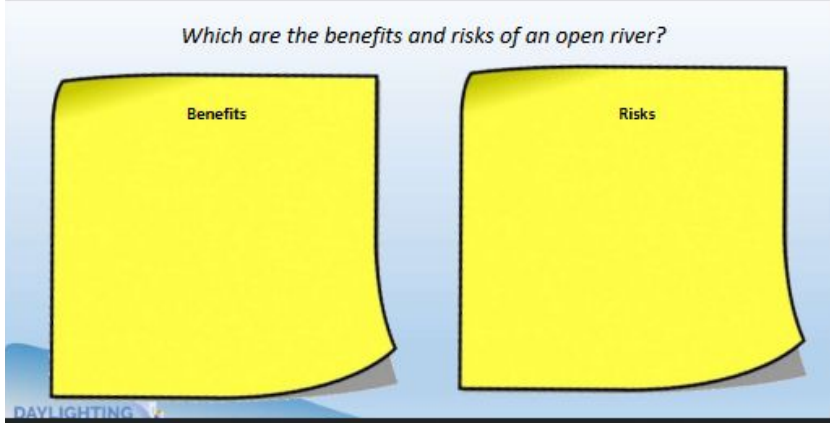
1.2 PRESENTATION OF THE PROJECT TO THE CLASS

Project objectives are presented to the class;

Brainstorming on local rivers helps to know the extent to which students know and what would like to know about the river (i.e. ecosystem, threats, human impacts etc.)

The presentation Introductory activity with the class can be used to this purpose: https://www.daylightingrivers.com/implementation/)





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How to implement a Daylighting Rivers project

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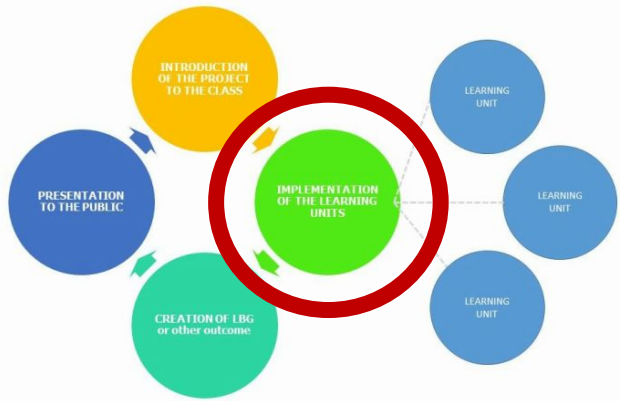


Source: Rafina Lyceum

3) IMPLEMENTATION

According to the interest shown by the students, the local river can be investigated further.

Choose and adapt one or more **Daylighting Rivers Learning Units** to your context.

Learning Units are developed following a specific model of Inquiry Based Learning.

https://www.daylightingrivers.com/implementation/

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How to implement a Daylighting Rivers project

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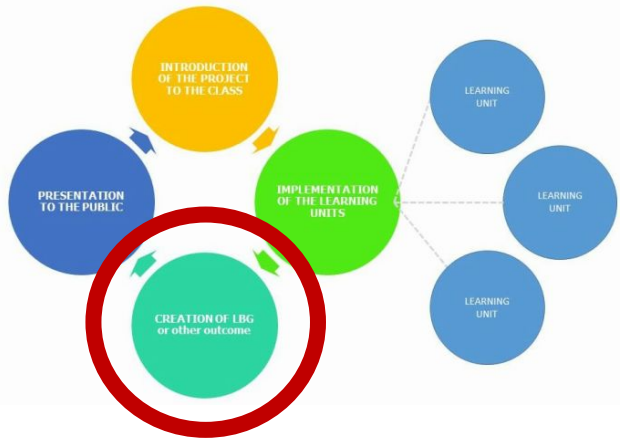

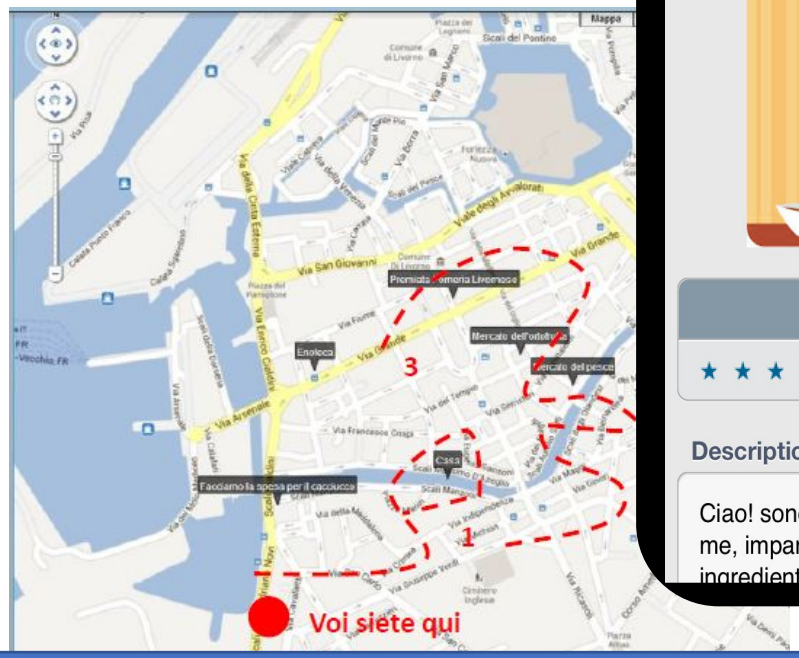

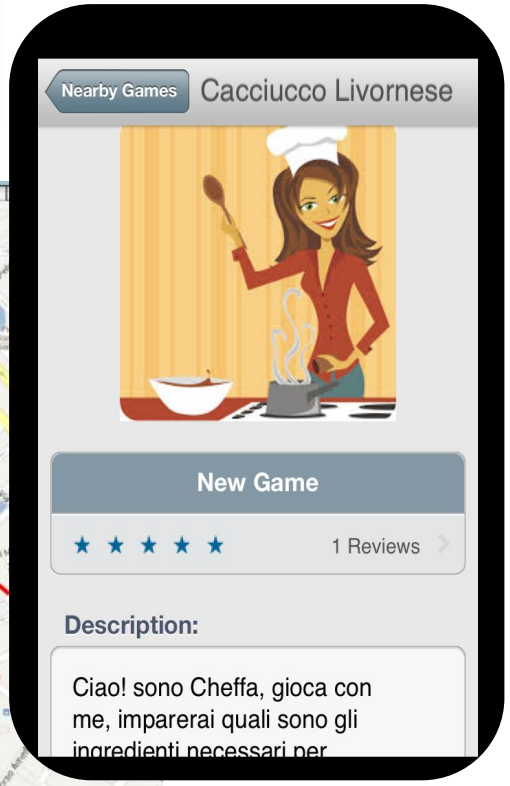

4) CREATIVE-TECH TIME!

The scientific and historical information collected in the previous step, is transferred to a creative and technological outcome.

Location Based Games allow to locate virtual information in the real space (Augmented Reality). The language change (scientific=>creative storytelling)

LBG enhance logical thinking, communication skills, art skills, creativity and technological skills.

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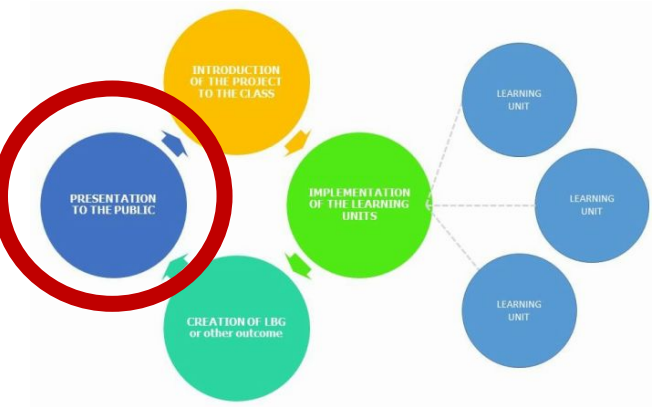

4) DISSEMINATION!

Promoting the results and outcomes is important to verify own learning and practice communication skills.

The project outcomes can be presented in front of the class, in events open to public (e.g. Science fairs, Open days, Exhibitions, Webinars, Seminars, Conferences, etc.)

In addition, the local community might be interested to achieve scientific data about the local river, and to start collaborating with schools.

https://www.daylightingrivers.com/implementation/

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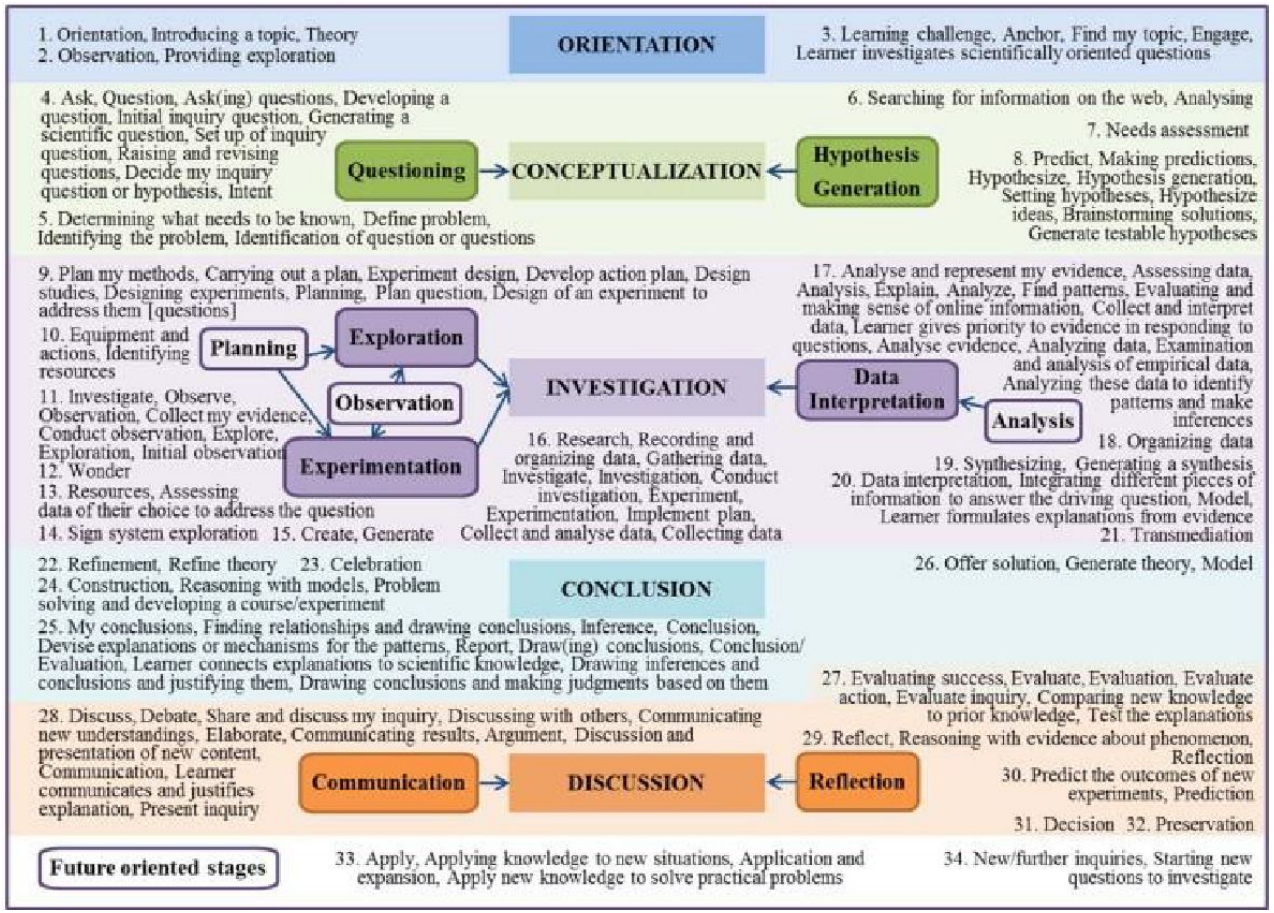
Adopted Inquiry Based Learning model

Inquiry Based Learning implies the application of the scientific method to investigate a specific issue. It is usually organized in phases along a cyclic model.

Daylighting Rivers adopted **Pedaste's model (Pedaste et al. 2015) for the development of the educational materials** due to its flexible description of the different phases, adaptable to different kinds of projects, such as simple explorative experiments or more complex scientific researches, and can be adapted to school subjects other than STEM.

https://www.daylightingrivers.com/implementation/

Scheme of the five phases of the summarized model described by Pedaste et al. (2015).



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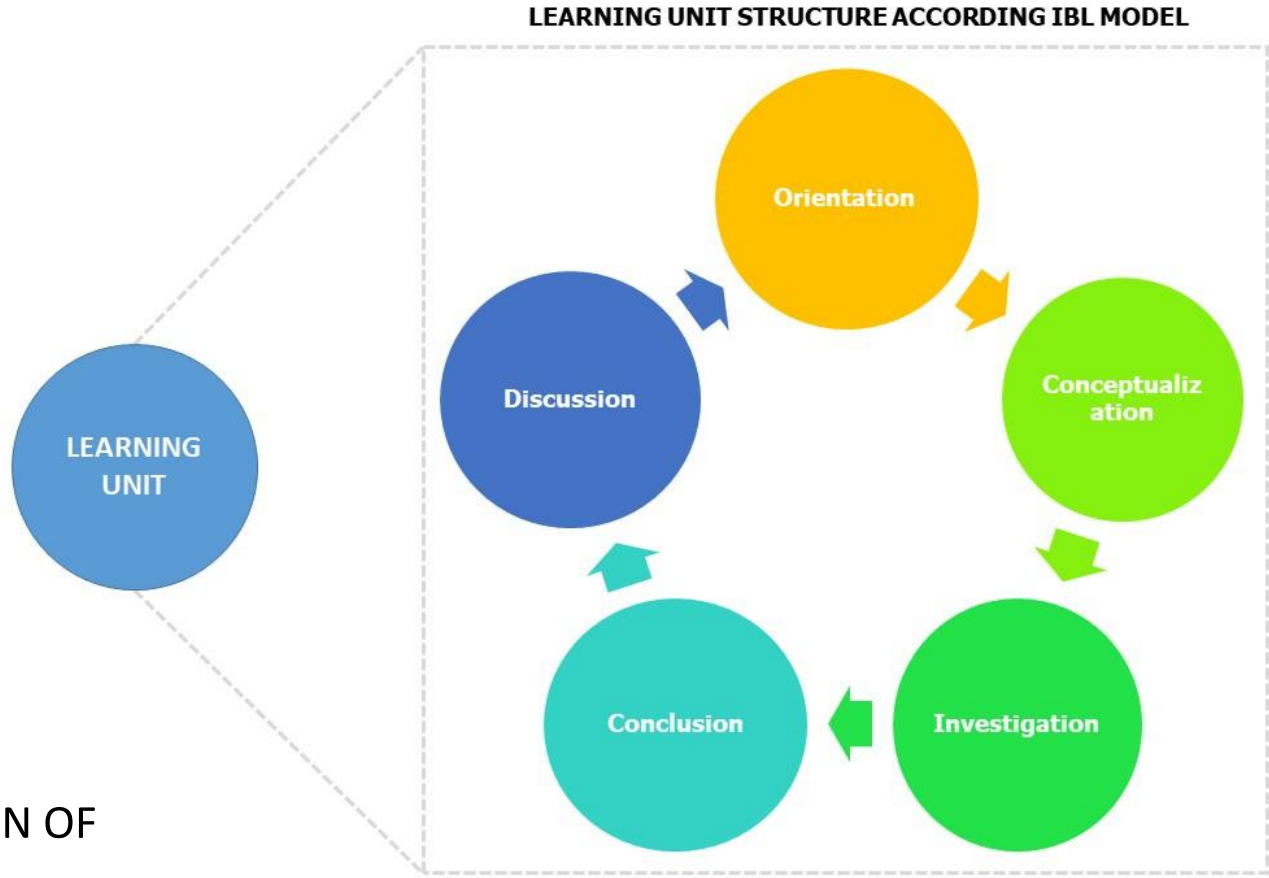
Adopted Inquiry Based Learning model

It is structured in five phases:



Scheme of the five phases of the IBL model applied to the Learning Units.

See the
LEARNING METHODOLOGY GUIDELINES APPLICATION OF THE PEDASTE'S MODEL INDAYLIGHTING RIVERS
https://www.daylightingrivers.com/implementation/

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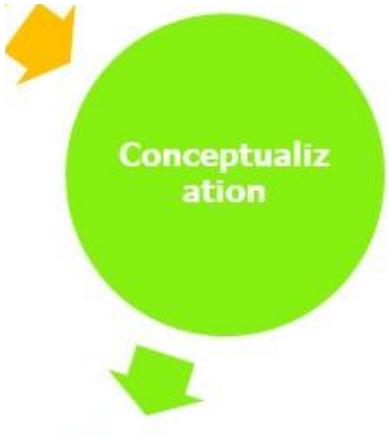
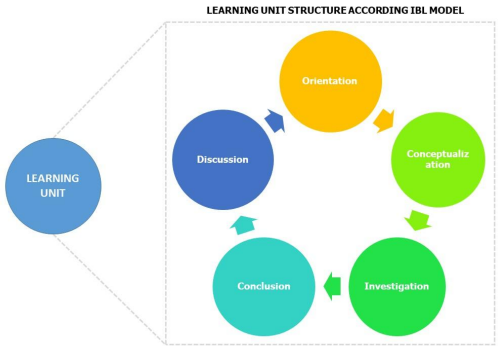
5 Phases of the IBL Model

Orientation: is the phase in which the interest and curiosity is stimulated in relation to the specific problem or topic. The teacher, as facilitator of the learning process, brainstorm the class on a specific issue (e.g. by showing a picture, a video, posing a question).

This phase should stimulates students in producing questions and hypothesis.



Conceptualization: includes the generation of questions and hypothesis to investigate or to test, in order to understand the problem and deepening the knowledge on the issue.



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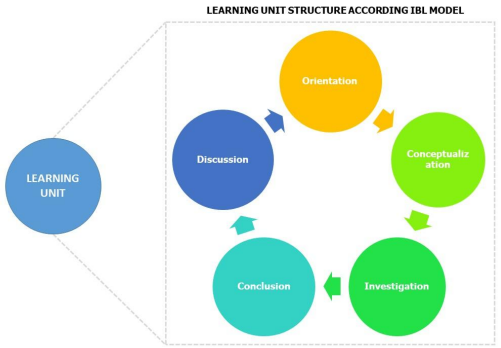
5 Phases of the IBL Model

Investigation: is the phase where curiosity is turned into action in order to respond to the stated research questions or hypotheses. Sub-phases are: Planning, Experimentation and Data Analysis and Interpretation.

Conclusion: gathers the results and the interpretations from the investigation. The students integrate the knowledge acquired in different learning activities to get an inclusive picture of the findings.



Discussion: includes the sub-phases Reflection and Communication. Reflection is defined as the process of reflecting on anything in the learner's mind, e.g. the success of the inquiry process, new problems for new inquiries. Communication is the presentation of the results to others, verifying own learning.

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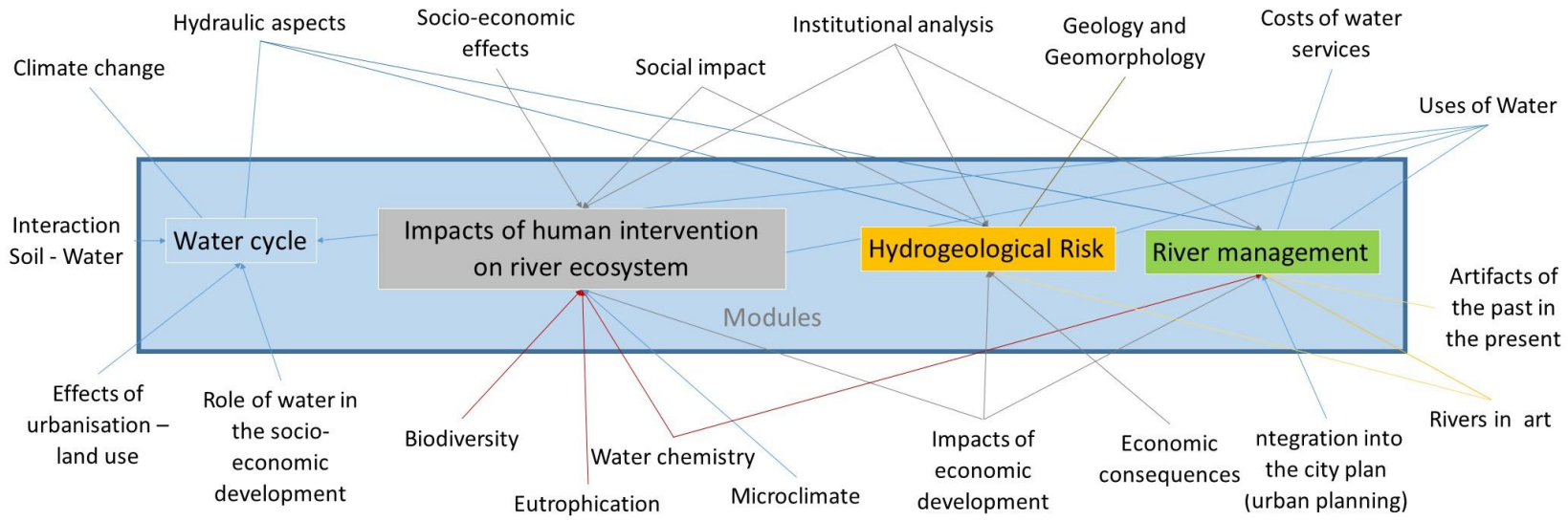
Educational materials

Based on such IBL model, Daylighting Rivers has developed 20 Learning Units dealing with 5 macro-themes:

- **Water cycle**
- **The impacts of human intervention on river ecosystem**
- **The hydrogeological risk**
- **River management**
- **Climate change**



https://www.daylightingrivers.com/macrothemes/

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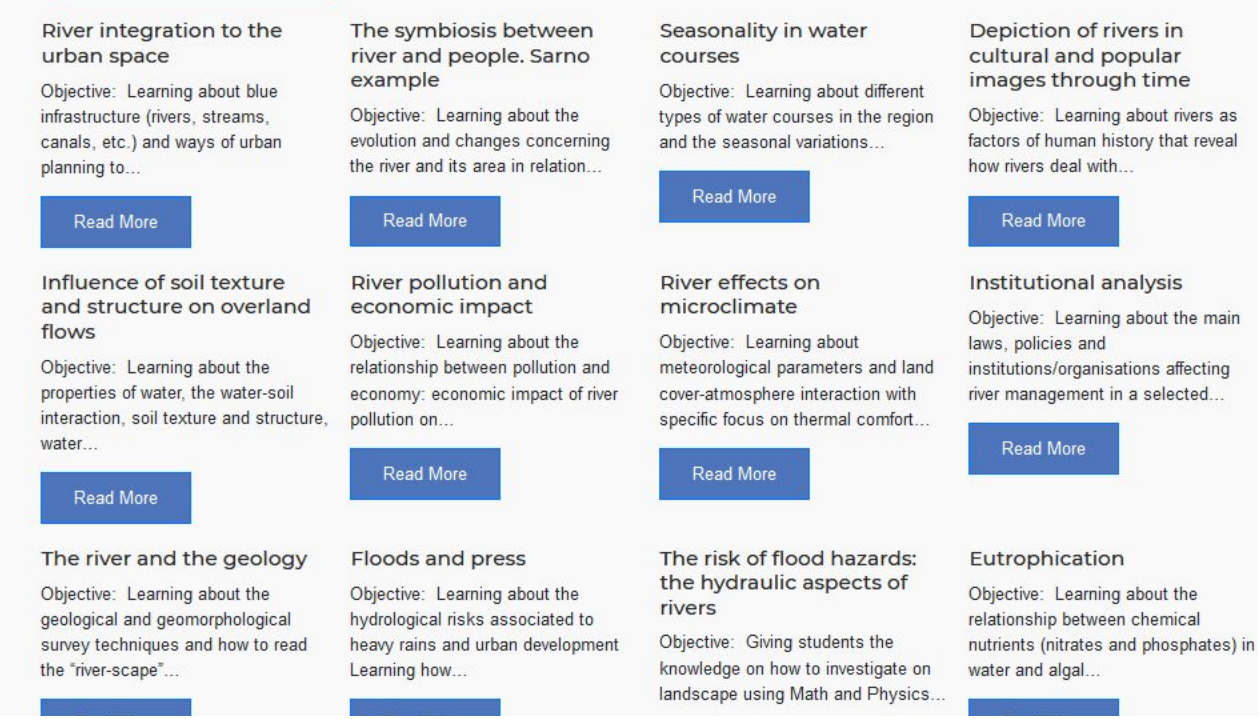
Educational materials – Learning Units

The Learning Units concern different topics such as the following:

- Vegetal/animal biodiversity of river ecosystems
- Eutrophication
- Integration of rivers into the city plan
- Artifacts in the past and in the present
- Rivers in art
- Geology and geomorphology
- Socio-economic effects
- Hydraulic aspects
- Microclimate effect of rivers
- Effects of urbanization and land use
- etc.

https://www.daylightingrivers.com/learning-units-list/



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Educational materials – Learning units

River integration to the urban space
Objective: Learning about blue infrastructure (rivers, streams, canals, etc.) and ways of urban planning to…

The symbiosis between river and people. Sarno example
Objective: Learning about the evolution and changes concerning the river and its area in relation…

Seasonality in water courses
Objective: Learning about different types of water courses in the region and the seasonal variations…

Depiction of rivers in cultural and popular images through time
Objective: Learning about rivers as factors of human history that reveal how rivers deal with…

Influence of soil texture and structure on overland flows
Objective: Learning about the properties of water, the water-soil interaction, soil texture and structure, water…

River pollution and economic impact
Objective: Learning about the relationship between pollution and economy: economic impact of river pollution on…

River effects on microclimate
Objective: Learning about meteorological parameters and land cover-atmosphere interaction with specific focus on thermal comfort…

Institutional analysis
Objective: Learning about the main laws, policies and institutions/organisations affecting river management in a selected…

The river and the geology
Objective: Learning about the geological and geomorphological survey techniques and how to read the "river-scape"…

Floods and press
Objective: Learning about the hydrological risks associated to heavy rains and urban development Learning how…

The risk of flood hazards: the hydraulic aspects of rivers
Objective: Giving students the knowledge on how to investigate on landscape using Math and Physics…

Eutrophication
Objective: Learning about the relationship between chemical nutrients (nitrates and phosphates) in water and algal…

Effects of urbanization on soil loss and water cycle
Objective: Giving students the knowledge on how to investigate the changes in soil use and…

The ecosystem of the estuary of the river and the eutrophication
Objective: Learning the relationship between chemical nutrients (nitrates and phosphates) in algal development Carrying out…

River ecosystems: plant biodiversity
Objective: Plan and carry out a research project following the steps of the scientific method…

River ecosystems: animal biodiversity
Objective: Plan and carry out a research project following the steps of the scientific method…

Biodiversity of the river ecosystem
Objective: Plan and carry out a research project following the steps of the scientific method…

Investigation of little meander – case study of Küçük Menderes (Turkey)
Objective: Learning carry out water quality management study at the river basin scale Discuss the…

Influence of soil texture and structure on overland flows (hydrogeological risk) – case study in the Agro Sarnese Nocerino.
Objectives: Identifying the factors that regulate the water infiltration in soils and the influence of…

https://www.daylightingrivers.com/learning-units-list/

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Example of Learning Unit

DAYLIGHTING SCIENCE EDUCATION FOR CIVIC ECOLOGY RIVERS


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SPAIN GE

River ecosystems: plant biodiversity

Home / The impacts of human intervention on river ecosystem / Water Cycle / River ecosystems: plant biodivers

Posted on 14 Ottobre 2019 | In The impacts of human intervention on river ecosystem, Water Cycle

Objective:

- Plan and carry out a research project following the steps of the scientific method
- Learn about plant diversity on the studied ecosystems and water quality

This learning unit includes outdoor activities for the identification of plant species in the river.

School subjects: science, biology, chemistry.

Total time estimated: 9 hours.

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WORKSHEETS

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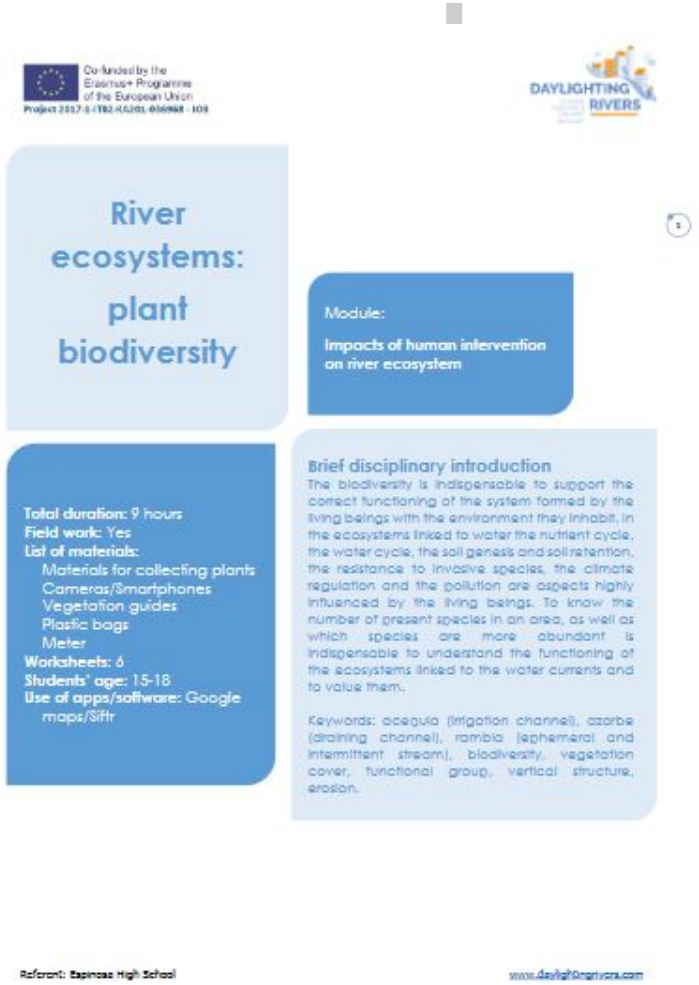
https://www.daylightingrivers.com/wp-content/uploads/2019/12/BIODIVERSITY_VEGETAL.pdf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River ecosystems: plant biodiversity

Module:

Impacts of human intervention on river ecosystem

Total duration: 9 hours
Field work: Yes
List of materials:
Materials for collecting plants
Cameras/Smartphones
Vegetation guides
Plastic bags
Meter
Worksheets: 6
Students' age: 15-18
Use of apps/software: Google maps/SiMr

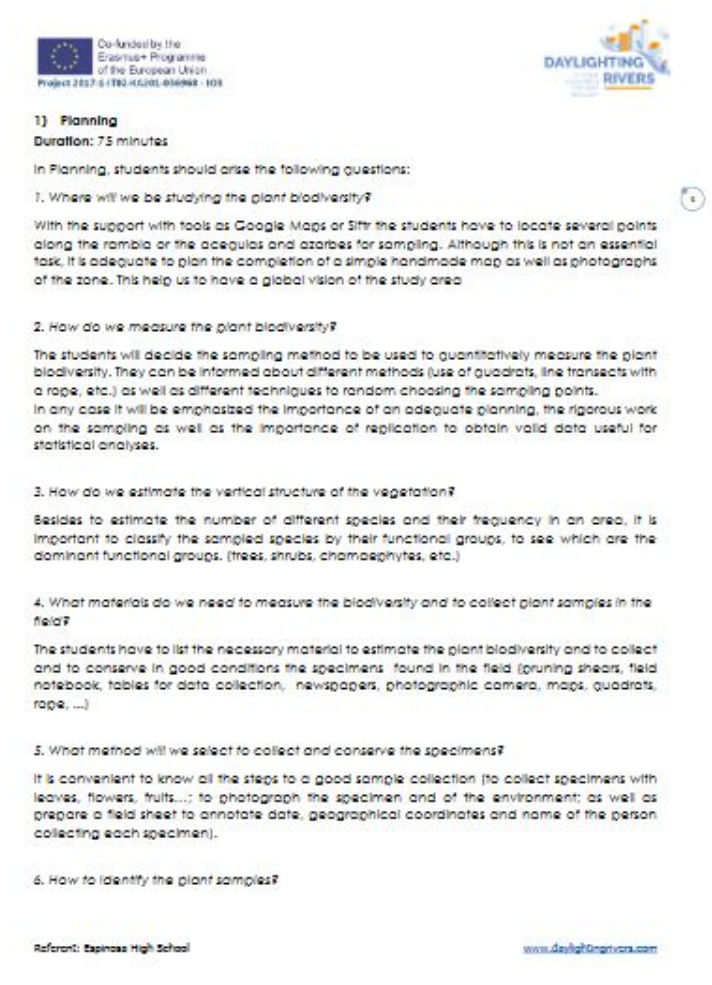
Brief disciplinary introduction

The biodiversity is indispensable to support the correct functioning of the system formed by the living beings with the environment they inhabit. In the ecosystems linked to water the nutrient cycle, the water cycle, the soil genesis and soil retention, the resistance to invasive species, the climate regulation and the pollution are aspects highly influenced by the living beings. To know the number of present species in an area, as well as which species are more abundant is indispensable to understand the functioning of the ecosystems linked to the water currents and to value them.

Keywords: acequia (irrigation channel), azarbe (draining channel), rambla (ephemeral and intermittent stream), biodiversity, vegetation cover, functional group, vertical structure, erosion.

Referent: Espinosa High School

www.daylightingrivers.com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1) Planning

Duration: 75 minutes

In Planning, students should arise the following questions:

1. Where will we be studying the plant biodiversity?

With the support with tools as Google Maps or SiMr the students have to locate several points along the rambla or the acequias and azarbes for sampling. Although this is not an essential task, it is adequate to plan the completion of a simple handmade map as well as photographs of the zone. This help us to have a global vision of the study area

2. How do we measure the plant biodiversity?

The students will decide the sampling method to be used to quantitatively measure the plant biodiversity. They can be informed about different methods (use of quadrats, line transects with a rope, etc.) as well as different techniques to random choosing the sampling points.
In any case it will be emphasized the importance of an adequate planning, the rigorous work on the sampling as well as the importance of replication to obtain valid data useful for statistical analyses.

3. How do we estimate the vertical structure of the vegetation?

Besides to estimate the number of different species and their frequency in an area, it is important to classify the sampled species by their functional groups, to see which are the dominant functional groups. (trees, shrubs, chamaephytes, etc.)

4. What materials do we need to measure the biodiversity and to collect plant samples in the field?

The students have to list the necessary material to estimate the plant biodiversity and to collect and to conserve in good conditions the specimens found in the field (pruning shears, field notebook, tables for data collection, newspapers, photographic camera, maps, quadrats, rope, ...)

5. What method will we select to collect and conserve the specimens?

It is convenient to know all the steps to a good sample collection (to collect specimens with leaves, flowers, fruits...; to photograph the specimen and of the environment; as well as prepare a field sheet to annotate date, geographical coordinates and name of the person collecting each specimen).

6. How to identify the plant samples?

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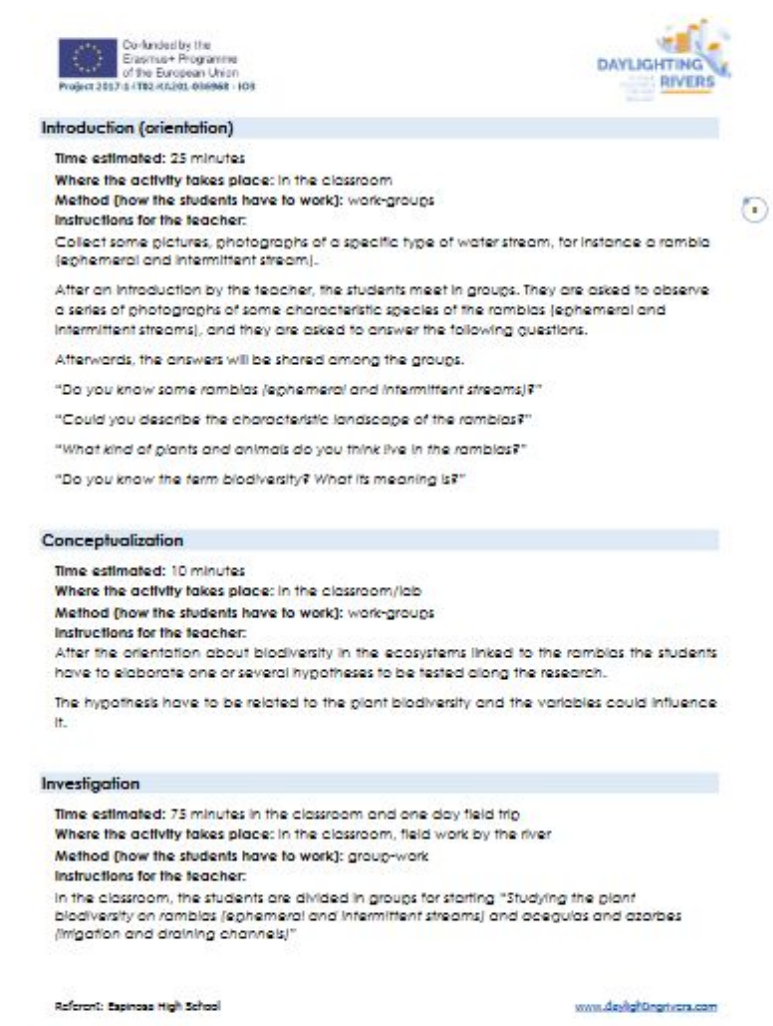

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Introduction (orientation)

Time estimated: 25 minutes
Where the activity takes place: In the classroom
Method (how the students have to work): work-groups
Instructions for the teacher:
Collect some pictures, photographs of a specific type of water stream, for instance a rambla (ephemeral and intermittent stream).

After an introduction by the teacher, the students meet in groups. They are asked to observe a series of photographs of some characteristic species of the ramblas (ephemeral and intermittent streams), and they are asked to answer the following questions.

Afterwards, the answers will be shared among the groups.

"Do you know some ramblas (ephemeral and intermittent streams)?"

"Could you describe the characteristic landscape of the ramblas?"

"What kind of plants and animals do you think live in the ramblas?"

"Do you know the term biodiversity? What its meaning is?"

Conceptualization

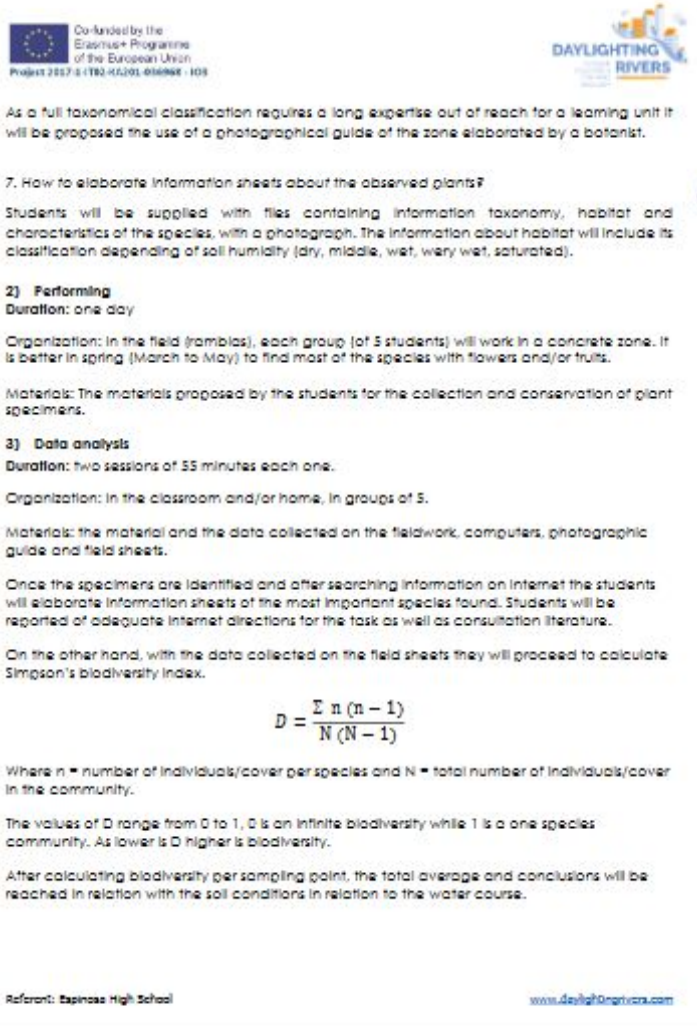
Time estimated: 10 minutes
Where the activity takes place: In the classroom/lab
Method (how the students have to work): work-groups
Instructions for the teacher:
After the orientation about biodiversity in the ecosystems linked to the ramblas the students have to elaborate one or several hypotheses to be tested along the research.

The hypothesis have to be related to the plant biodiversity and the variables could influence it.

Investigation

Time estimated: 75 minutes in the classroom and one day field trip
Where the activity takes place: In the classroom, field work by the river
Method (how the students have to work): group-work
Instructions for the teacher:
In the classroom, the students are divided in groups for starting "Studying the plant biodiversity on ramblas (ephemeral and intermittent streams) and acequias and azarbes (irrigation and draining channels)"

Referent: Espinosa High School



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As a full taxonomical classification requires a long expertise out of reach for a learning unit it will be proposed the use of a photographical guide of the zone elaborated by a botanist.

7. How to elaborate information sheets about the observed plants?

Students will be supplied with files containing information taxonomy, habitat and characteristics of the species, with a photograph. The information about habitat will include its classification depending of soil humidity (dry, middle, wet, wery wet, saturated).

2) Performing
Duration: one day

Organization: In the field (ramblas), each group (of 5 students) will work in a concrete zone. It is better in spring (March to May) to find most of the species with flowers and/or fruits.

Materials: The materials proposed by the students for the collection and conservation of plant specimens.

3) Data analysis
Duration: two sessions of 55 minutes each one.

Organization: In the classroom and/or home, in groups of 5.

Materials: the material and the data collected on the fieldwork, computers, photographic guide and field sheets.

Once the specimens are identified and after searching information on internet the students will elaborate information sheets of the most important species found. Students will be reported of adequate internet directions for the task as well as consultation literature.

On the other hand, with the data collected on the field sheets they will proceed to calculate Simpson's biodiversity index.

$$D = \frac{\Sigma\, n\,(n-1)}{N\,(N-1)}$$

Where n = number of individuals/cover per species and N = total number of individuals/cover in the community.

The values of D range from 0 to 1, 0 is an infinite biodiversity while 1 is a one species community. As lower is D higher is biodiversity.

After calculating biodiversity per sampling point, the total average and conclusions will be reached in relation with the soil conditions in relation to the water course.

Referent: Espinosa High School

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Conclusion

Time estimated: 3 hours
Where the activity takes place: In the classroom
Method (how the students have to work): group-work
Instructions for the teacher:
Part 1. Draft the conclusions of the experimentation
Duration: One session of 55 minutes

Materials: the map of the study area, the sheets elaborated by the different groups, the notes taken on the field and the results obtained by the biodiversity index calculation.

The groups provide their conclusions. They compare the plant biodiversity found in the different points and try to answer the questions asked in the conceptualization phase, testing their hypotheses.

Later students will write a report including:

- The identified species by them on the study area
- The vertical structure of the vegetation (relative abundance of trees, shrubs, subshrubs and herbs)
- The conclusions about the plant biodiversity
- Valuation of the importance of the species appearing in the zone (usefulness, protected species, ...)

The conclusions should determine plant richness and diversity of these ecosystems including the presence of endangered and protected species and the influence of some factors as teh distance to the watercourse as well as the presence of pollution point sources on the plant biodiversity. Also, they should include a valuation of the ramblas and other water courses as biodiversity refuges and hotspots in their area.

Part 2. Development of the presentation:
Duration: 2 hours

Organization: In the PC room and at home.

Materials: computers with presentations software (Powerpoint; Prezzi)

Each group will prepare a presentation on Power-point or Prezzi explaining steps on the research process and the obtained results.

Discussion and communication

Time estimated: 30 minutes, each group
Where the activity takes place: In the classroom, or in a public event (Multipurpose Classroom, Cultural Week, meeting with parents, etc.)
Method (how the students have to work): group-work or with the whole group
Instructions for the teacher:

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ANNEX II

ESTIMATION OF PLANT BIODIVERSITY. SIMPSON'S INDEX

To build with wood strips or fine rods a quadrat of 1x1 m to take data on different points of the area. To randomly select the points it can be launched a little ball and later center the quadrat on the point the ball fell

Other option is to locate the quadrat on concrete places to compare the biodiversity between them following a previous hypothesis

In any case, it is convenient to locate the sampling points in a map of the area

Once the quadrat is on place, they are counteed the number of individuals/cover of each species that appear within the quadrat and the following table is filled

Sample number:	
Species	Individuals/cover

Simpson's biodiversity index.

$$D = \frac{\Sigma\ n\ (n-1)}{N\ (N-1)}$$

n = number of individuals/cover per species

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ANNEX III

COLLECTING AND CONSERVING PLANTS FOR A COLLECTION

1. Corrugated carboard
2. Newspapers
3. Dryer
4. Pruning shears
5. Knife
6. Plastic bags
7. Notebook
8. Pencil (no bolpen, useless with rain)

Collect only specimens to be used

Collected plants should have leaves, stem, flowers and/or fruits in good state as this structres are used for the identification.

Specimens to be collected should have about 30 cm. Very large plants may be divided in three parts fitting that size. On the contrary, if specimens are little several ones should be collected.

Each specimen will be labelled and numbered. The number has to coincide with notes on the field notebook. In the case of ferns and orchids solid should be removed from the roots.

If the specimens were not pressed in the moment use large plastic bags, caring to conserve the bag closed to maintain a high humidity inside avoiding wilting.

Data for the specimen

- Number of the plant.
- Common name of the species.
- Name of the collector.
- Locality where it was collected.
- Notes about the site (climate, altitude), ecology of the plants, color of the flower, fruit, type of leaves and stem, type of soil, type of vegetation (forest, pasture, shrubland, etc.)

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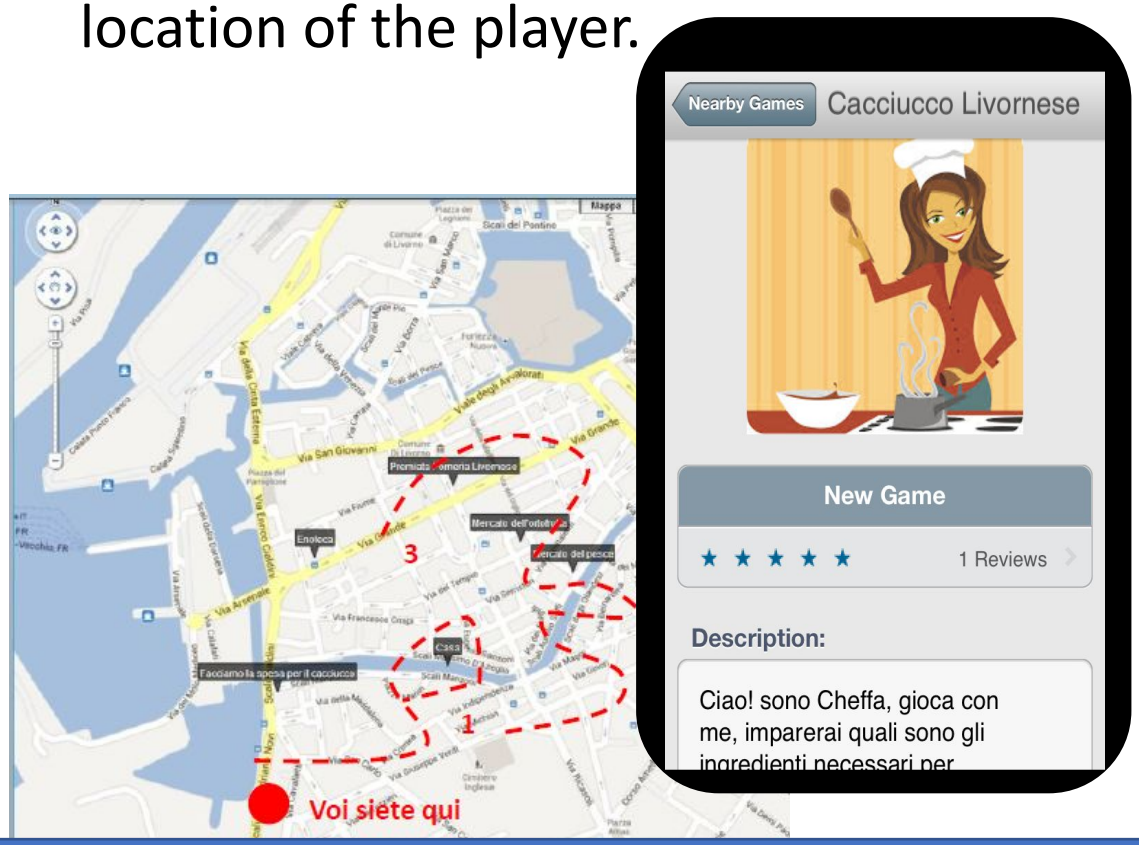
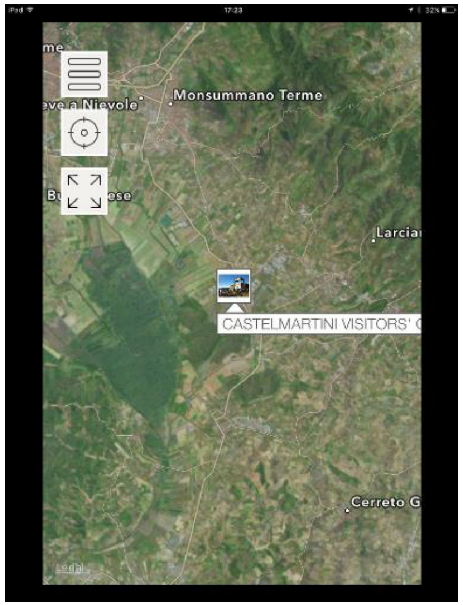
Location Based Games

As a form of Augmented Reality, a location-based game (LBG) is defined as a form of play designed to evolve on a device in motion, directly linking the game experience with the location of the player.



Location-based gaming offers great educational possibilities, as it allows educators and facilitators of learning to create constructivist experiences rich in educational content.



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Teaching resources

Materials available for the teachers:

- ✔ Learning methodology guidelines
- ✔ Use of Geographic Information Systems (QGIS) for educational projects on land studies
- ✔ Guidelines on how to develop a Location Based Game on Arisgames
- ✔ 20 Learning Units (with guidelines and worksheets) about 5 macro-themes connected to rivers and landscape

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Thanks for the attention!