

## INVESTIGATION - LEARNING MODULE

### The geology of water landscapes



*Olafur Eliasson, Riverbed (2014)*

#### Introduction

The structure of the Earth is made up of rocks. Rainwater beats on the surface, flows above and below ground level, ice moves slowly and the presence of lakes triggers physical, chemical and biological processes that constantly transform the landscape. Water in different ways constantly acts on the soil and shapes it. The study of the structure of the landscape serves to understand its formation, a story in which water and the force of gravity are the protagonists. The transformations may be slow or fast, but they involve the wide range of elements that make up the landscape: the presence of water and its dynamism contributes to the definition of landscape shapes through erosion, sedimentation and dissolution; with water chemical and biological processes are triggered on these forms which determine the colours of the landscape, but also the development of society and its culture.

Writers, painters and other artists have portrayed the landscape through their ability to express their vision of it.

The study of the territory through STEM provides an understanding of the dynamics and transformations of the landscape, this knowledge facilitates artistic representation, whether personal or collective.

The investigation can be implemented by following these steps:

#### 1) Planning

In Planning, students and teachers design their investigation activities on landscape, for instance they decide what to do, how to do it, when to do it, where to do it.

According to the topic or issue chosen for investigation, the class will need to identify what kind of actions to undertake in terms of literature review, hands-on research

activities, and it will identify the most suitable methods and list the needed materials to gather the necessary information.

Expert stakeholders from local research centres, universities and local authorities can be contacted as a valuable opportunity to access up-to-date knowledge and to make use of scientific equipment.

## 2) **Performing**

In Performing the investigation, the class implements the devised plan, and follows the steps of action along the project timeline. Data collection can regard environmental data during a field trip, a survey on the perceptions and views of the local community, or investigations on historical and artistic documents regarding the landscape of interest. Specific materials, equipment and worksheets can be used, allowing students to approach methods and software of common use in research. Experiments can be performed to understand the reason for certain phenomena.

## 3) **Data analysis and interpretation**

In Data analysis and interpretation, the collected data are analysed and interpreted in order to understand the extent of the environmental issue (generating new knowledge) and the relations between the factors and variables that are involved in the investigation.

## Objective of the Investigation

To learn about:

- ✓ The use of Art in the representation and expression of landscape
- ✓ Landscape studies using Mathematics and Physics
- ✓ Hydraulic aspect of the territory (risk, hazard and management)
- ✓ Connection between scientific disciplines

To be able to:

- ✓ observing geomorphological forms in landscape
- ✓ relating cause and effect of a natural event
- ✓ Plan a scientific experiment/project
- ✓ Retrieve public thematic spatial information from cartography
- ✓ Work in groups using art as a common expression

## HOW TO INVESTIGATE

**When:** After the Conceptualization Phase (Step 2)

**Time estimated:** 1-2 teaching sessions (at least 2 hours in total) + Filed work

**Where the activity takes place:** in the classroom and or outdoor

**Method (how the students have to work):** group-work or single students

**Art activity** - in every step of investigation students are invited to produce an artistic product about their investigations: texts, photos, drawing, videos, music or sound, meme (images, videos, piece texts, etc., typically humorous in nature, that is copied and spread rapidly by



Internet users, often with slight variations. (<https://en.wikipedia.org/wiki/Meme>), patchwork/collage, theatrical performances.

In the classroom, the students are divided in groups and the students could follow the suggestion in the table below.

<p><b>Planning</b></p>	<p>Trace the watercourses present in the investigation area with the help of maps of the site and direct observation. After documentation of articles and information from the textbook derive scientific and historical data. Some issues to find out could be: <i>physical phenomena (erosion and sedimentation), nature or man control, variability between winter and summer, what happened during the ice ages</i></p> <p>With teachers define and invite a list of stakeholders to work with to bring on the research (i.e.: University Department of Earth Science, University Department of Environmental Engineering, local watercourse managers)</p>
<p><b>Performing</b></p>	<p>With the help of stakeholders create an experiment to simulate the contraction of shapes by water.</p> <p>Erosion and deposition will depend on factors such as the slope of an inclined plane, the grain size of the sediment used. For the experiment, a plane, soil with different grain sizes, clods of soil with grass is needed. The water will first be run on the groundless plane and speed data and a description of the water motion will be taken. The plane will be inclined with different slopes.</p> <p>A layer of earth will then be spread on the plane and compacted. With the flow of the water the speed is registered and the description of the phenomenon was registered. A layer of soil is then spread over the plane and compacted. The speed of the water that will be flowing is then recorded and a description of what happens.</p> <p>The water will carry the sediment downstream and it will accumulate in cones of earth. The experiment will be repeated for different slopes. The angle of the accumulated sediments at the end of the table will also be measured.</p> <p>The same experiment can be done with vegetation, using sod with grass.</p>
<p><b>Data analysis and interpretation</b></p>	<p>All the data can be analyzed and discussed with stakeholders to highlight the relation with local situations in terms of social and scientific context. With the interpretation of the data the student would describe the local morphology and urbanization because of water presence.</p>



**WORKSHEET - The hydraulic aspects of water in landscape**

What does the speed of the flowing water depend on?

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Choose the correct words:

- 1) If the slope decreases, the speed increases / decreases
- 2) If the river bed shrinks up, the speed increases / decreases
- 3) If the river bed is impermeable the speed increases / decreases
- 4) If the roughness of a riverbed decreases, the speed increases / decreases
- 5) If the hidden and cemented watercourse is open (daylighting) the speed increases / decreases

Write below the formula for the kinetic energy

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In your opinion, if the flow velocity increases, does the kinetic energy increase or decrease? Can you say in what proportion?

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Write a consideration on the variation of speed and energy of the water in the stretches of the waterways that have been cemented like the hidden river.

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What happens in a river when speed and energy increase?

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How can you observe this phenomenon in the river?

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