



BRITEC – Bringing Research Into the Classroom

Learning Scenario

1. Title

**“Small retention - big deal. Plants store water and inhibit drought”
Field activities by the river.**

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Area of research

Activities should be conducted by the river, preferably in spring or summer. The research concerns water resources (in selected country), water retention, river regime, water velocity, observation of changes in riparian vegetation, river bathymetry, morphological activity of rivers, and meteorological parameters.

Subject(s)

Geography, Biology, Photography, Informatics

Topic

Selected country’s water balance. River network. Morphological activity of rivers. Biodiversity.

Age of students

15-20 years old



2. Introduction

Contribution of the CS project to Science in general

The main goal of this activity is to increase young people's awareness of water management and the impact of seasonal changes in riparian vegetation and microclimatic conditions on water retention.

By participating in the project, pupils acquire skills and apply the acquired knowledge into practice. Using various sources and methods, they develop creativity and independence, and develop skills such as: searching for and selecting information, measuring elements of the geographical environment, presenting research results. A very important aspect is shaping pupils' social competences such as: communication skills and teamwork.

As a result of participation in the project, pupils become more aware of the role of vegetation in the protection of the Earth's water resources.

Aim of the activities plan and learning objectives

Detailed objectives are divided into blocks of content and specific pupils' skills.

1. Water balance

Pupil can:

- characterize the components of country's water balance
- describe water resources in country and in given region
- indicate areas of risk of water deficit
- explain the causes of water scarcity in selected regions of the country
- explain the causes and effects of floods
- provide measures to prevent floods and water shortages

2. River network

Pupil can:

- provide the landscape and economic functions of rivers
- name the elements of the river valley
- read from the map basic data about the river: river source, estuary, river length, basin, catchment area, tributaries
- search for a hydrological station and get figures on the river's water status and flow rate
- provide the GPS coordinates of the measurement site on the river
- describe the structure of the river on the basis of hydrological data
- calculate the speed of the river
- plot the transverse profile of the river bed

3. Morphological activity of rivers

Pupil can:

- compare the features of the river in the upper, middle and lower reaches



- list examples of forms resulting from the erosion and accumulation of rivers
- indicate the possibilities of developing floodplains

4. Microclimate

Pupil can:

- perform simple meteorological measurements (air temperature, atmospheric pressure, air humidity, cloud cover) and hydrological measurements (water temperature)
- find the nearest weather station and read basic meteorological data (rainfall, wind speed and direction)

5. Riparian vegetation

Pupil can:

- identify plants by the river
- explain the impact of climate change on vegetation

Summary of activities

Number of activity	Name of activity
1.	The division of pupils into four task groups (3, 4 pupils per group)
2.	Remind the subject of classes and discussion on the safety rules during field campaign
3.	Assignment of tasks to each group, distribution of worksheets and measuring equipment
4.	Introduction to the topic of classes
5.	Working with the map - indicating the site of measurements, searching for the source of the river, estuary, basin, tributaries
6.	Determination of the geographical coordinates of the measurement site using GPS
7.	Marking the elements of the river valley in the picture
8.	Performing the measurement of the water velocity in the river in accordance with given instructions
9.	Measurement of the river bed width and the river depth
10.	Search and analysis of the necessary figures from the nearest



11. Perform simple meteorological measurements and hydrological surveys using given instruments
12. Doing photographic documentation
13. Filling out worksheets
14. Observation and identification of riparian vegetation
15. Observation and recognition processes and landforms resulting from the morphological activity of the river

H
O
M



3. Detailed description of each activity (to be completed as many times as activities are implemented)

First Part: Aim of the activity

Before going on field campaign, pupils are divided into four groups of 3 to 5 pupils. The teacher acquaints the pupils with the place and course of the lesson. Then she/he reminds pupils about the subject of the lesson and discusses the safety rules. Members of each group choose a leader who will be responsible for the work of the entire team. Leaders draw sets with tasks to be performed (work sheets) and receive equipment to perform measurements, e.g. compasses, thermometers, barometers, measuring tapes. The teacher presents the objectives of the lesson and introduces students to the topic of the lesson. Explains the basic concepts: source, estuary, main river, basin, river current, catchment, watershed. The teacher presents the Earth's water balance and its diversity in various climatic conditions. It describes the types and size of water resources in selected country and the region. Students describe the economic and landscape functions of rivers and the causes, effects and ways of preventing water shortages and floods. They indicate the importance of vegetation in counteracting the effects of drought and floods.

Each group receives a topographic map of the area and marks the place where measurements will be taken as well as the direction of the river flow. Then, each group uses GPS to determine the geographic coordinates of the measurement site. Based on the knowledge and observation of the river, pupils enter into the worksheet an information on the elements of the river valley (riverbed, river valley, floodplain). According to the instructions, pupils measure the time taken by the float to cover the designated part of the river. They repeat the measurement five times. Then they calculate the arithmetic mean of the obtained results. This is how they measure the speed of the river. The next task is to measure the wetted perimeter. For this purpose, pupils measure the width of the river (they attach a measuring tape to both sides of the river and measure the depth along it). Having the results of the measurements, pupils make a drawing of the river cross-section on a graph paper. The next activity is to describe the structure of the studied river (according to the instructions). The student finds the website of e.g. in Poland: the Institute of Meteorology and Water Management, and finds hydrological data on the monthly values of the flows of the selected river. Then, pupil presents obtained data in the form of a line chart. The pupil is able to analyze the changes in the volume of flow during the year and give reasons for the minimum and maximum values. The next task is to perform simple meteorological measurements (air temperature, atmospheric pressure, amount of cloud cover, wind direction) and compare them with the data from the nearest weather station. By analyzing the data, pupils learn about the microclimate of the river. Using their own knowledge and



the key to designate plant species, students write the names of plants growing on the river banks. They also make photographic documentation of plants. As a result of observations, they describe the course of the river (water velocity, transported material, size of the river bed, slope) and recognize morphological activity of rivers. They also present the morphological forms created as a result of the destructive or constructive activity of the river.

Pupils insert all measurements and collected data on their worksheets. During the next meeting, this time in the classroom, each group presents its topic. After the presentation of all groups, a discussion takes place and conclusions are drawn from the participation in the project.

By performing the described activities, students learn to independently take measurements, search for the necessary data and analyze it, and present the test results. They can formulate conclusions. They learn to use computer technology to acquire and process data. Moreover, work in groups has great shaping and educational values. Participation in the project teaches how to solve problems as well as take responsibility for the environment.

Second Part: Suggested procedure

Preparation time	1 Month
Teaching time	Field campaigns by the river - 3 hours (180 minutes) Preparation time - 2 weeks Activities in the classroom - Summary - 2 lesson hours
Online teaching material	List here all the links of online tools, applications and support documents that you will use during your activities such as: Padlet, Kahoot, etc. Here are examples of external sources in Polish. For each country, teacher needs to find national versions. https://meteo.imgw.pl/ website of the national meteorological survey. https://hydro.imgw.pl/ website of the national hydrological survey. https://atlas.roslin.pl/ website with guidelines for plants recognition.



	<p>If no national services are available, students may use global services, e.g.:</p> <p>Climatic data, climate graphs: https://en.climate-data.org/</p> <p>Actual weather conditions: https://www.yr.no/en/</p> <p>Website with guidelines for plants recognition: http://www.worldfloraonline.org/</p>
<p>Offline teaching material</p>	<p>List here all the offline tools, such as: paper, glue, etc.</p> <p>Topographic map of the area, thermometer, barometer, compass, measuring tape, stopwatch, geodesic pole, graph paper, pencil, camera or smartphone with a camera and GPS, worksheets (one per group), atlases and keys for marking plants, laptop with Microsoft Excel and internet access.</p>
<p>Citizen science purpose of the activity (if any) *</p>	<p>Outline questions or guidelines required for collecting data</p> <ol style="list-style-type: none"> 1. What will our project be about? 2. What will our tasks concern? 3. What are we going to achieve in the project?
<p>* Guidance for teachers</p>	<p>Add some kind of guidance for teachers about why it is important to address those questions and collect those data.</p>

Third Part: Advice on methodology

It is the best to carry out chosen project topic in the field, by the river. However, if this is not possible, then classes can be conducted in a classroom with Internet access. Using Google Maps and Google Street View, we can virtually move to the selected river. All planned activities can be performed in the classroom, except for measuring water speed and depth.

Fourth Part: Educational analysis

1. Investigative fieldwork where answers are definite and experimentally determined.
2. Collaborative learning, strong emphasis on group work.
3. Outdoor education. Learning outside the school building in a 'real' environment
4. Mobile learning. We gain access to knowledge via smartphones
5. The transition from books to online resources
6. The shift from "what you know" to "what you can do"



4. Assessment after implementation of the activities plan

Student's learning

During field campaigns, pupils work in groups, carrying out tasks listed on worksheets. Each group has different tasks. The teacher observes the work flow and helps if necessary. Summary of field activities takes place in the classroom during a scheduled class. Then the groups present their research. They do it in whichever form they wish, e.g. description, presentation, film, portfolio. Each student is assessed. The final grade depends on the involvement of pupils in the field campaigns and the quality and presentation of the results of the work.

Citizen Science experience

Problems that may arise during the project:

- lack of motivation of students to participate in the project
- problems accessing river, if it is too far (this activity is recommended for schools located in the vicinity of a river)
- no internet access
- no access to required data (meteorological, climatic data, hydrological data or plant key) in national languages
- student's outfit not adjusted to weather conditions
- group conflicts



5. Bibliography

1. B. Dziedzic, B. Korbel, E.M. Tuz. Program nauczania geografii w zakresie rozszerzonym dla liceum ogólnokształcącego i technikum – Oblicza geografii, Nowa Era
2. R. Malarz, M. Więckowski, P. Kroh, Oblicza geografii. Podręcznik dla liceum ogólnokształcącego i technikum, Nowa Era 2019r.
- 3 Obserwacja zmian sezonowych roślinności nadbrzeżnej i warunków mikroklimatycznych rzeki Prezentacja. Monika B. Kalinowska Instytut Geofizyki PAN
4. A. Woś ABC meteorologii. Wydawnictwo naukowe UAM 1995r.
5. <https://meteo.imgw.pl/>
6. <https://hydro.imgw.pl/>
7. <https://atlas.roslin.pl/>
8. <http://www.allourideas.org/trendiez/results>
9. <http://www.up.poznan.pl/>

External sources available in English:

Plant key: <http://www.worldfloraonline.org/>

The current weather may be checked on the website <https://www.yr.no/en/> - available in English and for whole world.

Climatic data, climate graphs: <https://en.climate-data.org/>

6. Annexes

Any document needed for the development of the activity.

Four worksheets

WORKSHEET 1

PROJECT: Small retention - big deal. Plants store water and inhibit drought

SUBJECT: River network

Date of observation and measurement:

Group number 1

Composition of the group	Name and surname
Leader	
Members	<ul style="list-style-type: none">••••

MIND THE SAFETY RULES!

- be careful when carrying out measurements and observations
- stay close to your group
- do not go into the river

Task 1 Enter the geographic coordinates of the measurement site using the Google Maps application.

.....
.....



Task 2 Using your own knowledge and available teaching materials, explain the concepts:

a) main river

.....

b) first-order tributary

.....

c) river basin

.....

d) current

.....

e) catchment area

.....

f) watershed

.....

g) river regime

.....

h) flood

.....

i) low flows

.....

j) retention

.....

Task 3 Complete the table (data from the topographic map)

The source of the river and the height above sea level	
Estuary of river and the height above sea level	
The length of the river	
Main river basin	
Cities through which it flows	
Tributaries	
Reservoirs on the river (if they are any)	



Task 4 Locate a river on the map and follow these instructions:

- Mark with X the site of measurements on the map
- Define the direction in which it flows and mark with an arrow on the obtained fragment of the topographic map
- Mark the source of the river on the map (S) and the estuary (E)
- Identify to which main river, the river basin belongs (use the tourist map)
- Determine the order of the tributary of the studied river

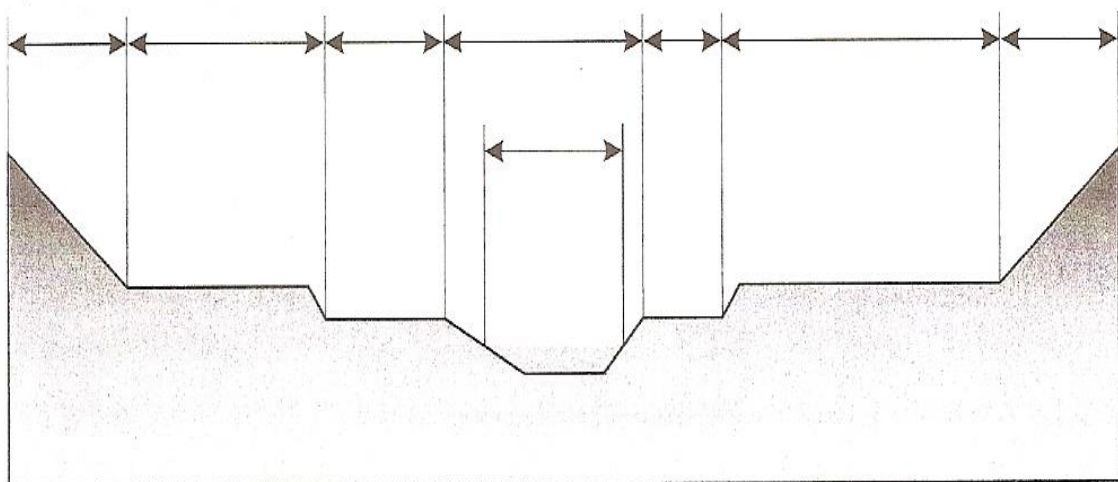
Task 5 Based on your own knowledge and observations, enter the elements of the river valley on the transverse profile using the following abbreviations:

R- River bed

FT- floodplain terraces

OT - overwater terraces

RC- river corridor



Schematic profile of the river valley

Task 6 Measure the flow of the watercourse and formulate a conclusion for an average velocity of flow of the river on the tested section.

INSTRUCTION

- Choose as straight section of the river as possible.
- Measure a distance of 10 m with a measuring tape along the river bank.
- A person standing 1 meter in front of the starting line throws a stick at a predetermined distance from the river bank.
- At the moment the stick passes through the starting line, pupils start the stopwatches and measure the time (t) for the stick to reach the finish line (10 meters - S).



- When the stick (float) passes the finish line, the person standing there shouts STOP and stops the stopwatch.
- Read the flow time of the stick directly from the stopwatch.
- Repeat the measurement five times and calculate the average flow velocity.

Calculate the velocity using the formula: $V = S/t$
 S - length of the section t - time

Measurement results:

The flow velocity

Measurement I:[m/s]

Measurement II:.....[m/s]

Measurement III:[m/s]

Measurement IV:[m/s]

Measurement V:[m/s]

Average velocity:..... [m/s]

Task 7 Take measurements of wetted perimeter and then draw the cross-section on a graph paper.

a. the width of the river bed - stretch the measuring tape perpendicular to the direction of water flow so that the beginning of the tape (0.00m) is on the left bank of the river. The tape is to be unrolled until the right edge begins. Read the measured value.

b. depth of the river bed - set several measuring points at equal distances (e.g. 0.5 m or 1 m) on an unfolded fixed measuring tape. Using a survey pole or a string with a weight, measure the depth of the river bed trough at the established points. If there are irregularities, compact the depth measurement points to capture the characteristic bends of the bed bottom.

Distance from the left bank (cm)	Depth (cm)
0	
50	
100	
150	
200	



Task 8 Following the instructions, describe the structure of the river and answer the following questions:

8.1 Characterize the hydrological regime of the studied river.

8.2 What are the minimum and maximum flow rates?

8.3 In which months (seasons) were the highest and lowest flows observed?

8.4 What kind of feed is indicated by the distribution of flows?

INSTRUCTION – River system

a) Find the hydrological station closest to the river under study

In Poland, use, for example, the map on the website <http://monitor.pogodynka.pl>

b) find hydrological data from that station

In Poland, go e.g. to the website of the Institute of Meteorology and Water Management <https://dane.imgw.pl> and open the measurement and observation data tab. On the next screens download in order: hydrological data> monthly> 2016. Use the data for 2016 as those for the following years may be incomplete.

c) Prepare the data for elaboration and analysis

Download the file Mies_2016.zip. Unpack it. Open the file in a spreadsheet. Note that the downloaded data is not separated - they are all in the first column of the following rows. Select the first column and then split the data using the Text As Columns tool in the Data menu. There is text data in all cells of the table. Format the table so that they become numeric data. Select all cells with numeric data. Right-click and select Format Cells. Then, from the Numbers menu, choose the Numeric category. Numbers with decimals replace periods with commas. Filter the data in the following columns: C (select the river you are interested in), B (select the measurement post you are interested in), F (select the value 3, which is the maximum flow value). To filter the data, select the first row of the table and then use the Filter Tool from the menu. There will be twelve rows left in the table - one for each month. note that the downloaded data is for the hydrological year, so the first row in the table contains data from last November.

d) Develop hydrological data

Analyzing the obtained data on the volume of flow will be easier if you present it in a graphic form, e.g. on a chart. Make a line graph using the data in column H. They represent the maximum monthly flow rate in m³/s.

e) Describe changes in the flow rate in the selected river during the year



Analyze the amount of flow. Write down the answers to the questions given above (8.1-8.4).

8.1 The hydrological regime of the studied river:

8.2 The minimum flow rate: _____

the maximum flow rate: _____

8.3 The highest flows observed in _____

and the lowest flows observed in _____

8.4 Kind of feed: _____

WORKSHEET 2

PROJECT: Small retention - big deal. Plants store water and inhibit drought

SUBJECT: RIVER MICROCLIMATE

Date of observation and measurement:

Group number 2

Composition of the group	Name and surname
Leader	
Members	<ul style="list-style-type: none"> • • • •

MIND THE SAFETY RULES!

- be careful when carrying out measurements and observations
- stay close to your group
- do not go into the river

Task 1 Enter the geographic coordinates of the measurement site using the Google Maps application.

.....
.....

Task 2 Using your own knowledge and available teaching materials, explain the concepts:

a) main river

.....

b) climate

.....

c) weather



.....
d) microclimate

.....
e) current air temperature

.....
f) average air temperature

.....
g) air amplitude

.....
h) atmospheric pressure

Task 3. Complete the table (data from the topographic map)

The source of the river and the height above sea level	
Estuary of river and the height above sea level	
The length of the river	
Main river basin	
Cities through which it flows	
Tributaries	
Reservoirs on the river	

Task 4 List the economic and landscape functions of rivers

- a).....
- b).....
- c).....
- d).....

Task 5 Locate a river on the map and follow these instructions:

- a) mark with X the site of measurements on the map
- b) define the direction in which it flows and mark with an arrow on the obtained fragment of the topographic map
- c) mark the source of the river (S) and the estuary (E) on the map



d) identify to which main river, the river basin belongs (use the tourist map)

e) determine the order of the tributary of the studied river

Task 6 Using meteorological instruments or observations, measure the following parameters:

a) air temperature in °C

.....

b) water temperature

.....

c) atmospheric pressure

.....

d) cloud cover

.....

e) air humidity

.....

f) wind direction and speed

.....

g) precipitation

.....

h) other weather phenomena

.....

Task 7

Using data from the nearest weather station enter: (e.g. in Poland, use the map on the website <http://monitor.pogodynka.pl>)

a) air temperature

.....

b) water temperature

.....

c) atmospheric pressure

.....

d) wind speed

.....

e) the amount of precipitation

.....

Task 8 Describe the course of air temperature throughout the year and answer the questions. Follow the instructions.

8.1 In which months is the average monthly air temperature above and below 0°C?

8.2 In which months is the air temperature the highest and the lowest?

8.3 What are the values of the annual mean air temperature and the mean annual air temperature amplitude?



Instruction

a) Find the weather station closest to the measurement site.

E.g. in Poland, use the map on the website <http://monitor.pogodynka.pl>

The current weather may be checked on the website <https://www.yr.no/en/> - available in English and for whole world.

b) Find meteorological data

You need to find them on the websites of institutions that collect, compare and analyze climate data, e.g. in Poland:

<http://www.wordclimate.com>, <https://dane.imgw.pl/>

<http://www.pogodynka.pl/polska/daneklimatyczne/>

For global locations you may search on the portal: <https://en.climate-data.org/>

c) Develop meteorological data

Analyzing the data on the course of air temperature throughout the year will be easier if you present them graphically, e.g. on a chart.

d) Describe the course of air temperature in a selected place during the year

Analyze the course of air temperature. Write down the answers to questions given above (8.1-8.3).

8.1 The average monthly air temperature is above 0°C in:

and below 0°C in:

8.2 The air temperature is the highest in:

and the lowest in:

8.3 The annual mean air temperature is: _____ °C

The mean annual air temperature amplitude is _____ °C

Your calculations:

WORKSHEET 3

BRINGING RESEARCH INTO THE CLASSROOM

PROJECT: Small retention - big deal. Plants store water and inhibit drought

SUBJECT: Sculptural activity of rivers

Date of observation and measurement:

Group number 2

Composition of the group	Name and surname
Leader	
Members	<ul style="list-style-type: none"> • • • •

MIND THE SAFETY RULES!

- be careful when carrying out measurements and observations
- stay close to your group
- do not go into the river

Task 1 Enter the geographic coordinates of the measurement site using the Google Maps application.

.....

Task 2 Using your own knowledge and available teaching materials, explain the concepts:

- main river
.....
- erosion
.....
- estuary
.....
- the source of the river

- upper, middle and lower course
- meanders
- oxbow lakes
- pebbles

Task 3 Complete the table (data from the topographic map)

The source of the river and the height above sea level	
Estuary of river and the height above sea level	
The length of the river	
Main river basin	
Cities through which it flows	
Tributaries	
Reservoirs on the river	

Task 4 List the economic and landscape functions of rivers

- a)
- b)
- c)
- d)

Task 5 Locate a river on the map and follow these instructions:

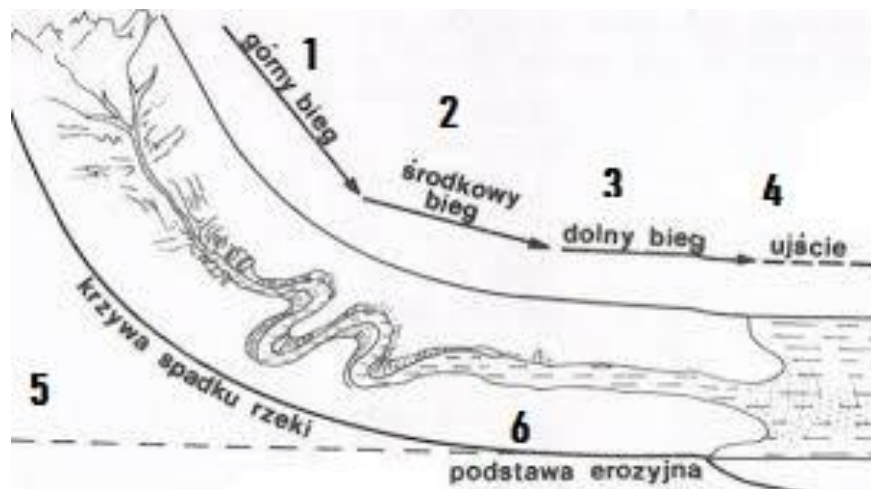
- a) mark (X) the place of measurements on the map
- b) define the direction in which it flows and mark with an arrow on the obtained fragment of the topographic map
- c) mark the source of the river on the map (S) and the estuary (E)
- d) identify to which main river, the river basin belongs (use the tourist map)
- e) determine the order of the tributary of the studied river under

Task 6 Using the knowledge or the available teaching materials, provide the course of the river and its characteristics in the place where you are taking measurements.

COURSE OF THE RIVER -

CHARACTERISTICS -

Task 7 The figure shows the longitudinal profile of a river. Analyze the longitudinal profile of the river and give answers:



Legend:

- 1 upper course
- 2 middle course
- 3 lower course
- 4 estuary
- 5 river slope curve
- 6 erosion base

- List three factors that determine the intensity of river activity

- 1.-
- 2.-
- 3.-

- What is the erosion base of the river?

.....

.....

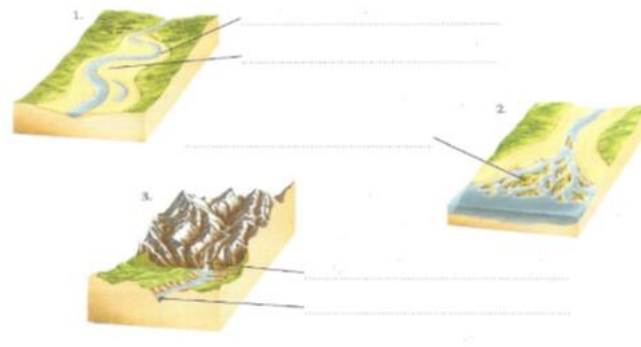
- Which river course is dominated by the submerged erosion process?

.....



- Which the river course is dominated by lateral erosion?
.....
- In which stretch of the river the accumulation process dominates?
.....

Task 8 Complete the drawings by entering the names of sculptural processes listed below in the appropriate places. Processes: submerged erosion, back erosion, lateral erosion.



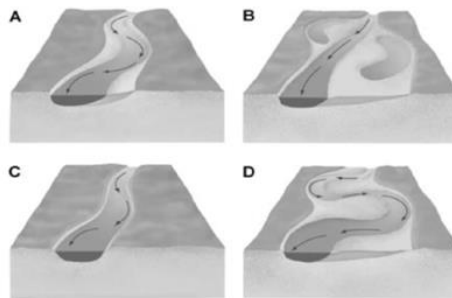
Task 9 In the appropriate places in the table enter the letters corresponding to the mentioned processes and phenomena characteristic for particular river courses.

- A - the predominance of lateral erosion
- B - transport of boulders and rock crumbs
- C - a very wide river valley
- D - predominance of accumulation over erosion
- E - V-shaped valleys
- F - predominance of depth erosion
- G - silt and clay accumulation
- H - meanders

Upper course	Middle course	Lower course

Task 10

Arrange the illustrations below so that they show the successive stages of the formation of oxbow lakes. To do this, enter the letters in the appropriate places in the diagram.



□-□-□-□

Task 11.

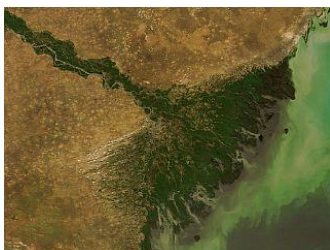
Add to the drawings the forms of sculpture resulting from the activity of rivers, the process and the section of the river.



Form of sculpture: _____

Process: _____

Course of the river: _____



Form of sculpture: _____

Process: _____

Course of the river: _____



Erasmus+



Form of sculpture: _____

Process: _____

Course of the river: _____

BRINGING RESEARCH INTO THE CLASSROOM



Form of sculpture: _____

Process: _____

Course of the river: _____



Form of sculpture: _____

Process: _____

Course of the river: _____



Form of sculpture: _____

Process: _____

Course of the river: _____



Form of sculpture: _____

Process: _____

Course of the river: _____



Erasmus+



Form of sculpture: _____

Process: _____

Course of the river: _____



BRINGING RESEARCH
INTO THE CLASSROOM

WORKSHEET 4

PROJECT: Small retention - big deal. Plants store water and inhibit drought.

SUBJECT: Riparian vegetation

Date of observation and measurement:

Group number 2

Composition of the group	Name and surname
Leader	
Members	<ul style="list-style-type: none"> • • • •

MIND THE SAFETY RULES!

- be careful when carrying out measurements and observations
- stay close to your group
- do not go into the river

Task 1. Enter the geographic coordinates of the measurement site using the Google Maps application.

.....

Task 2 . Using your own knowledge and available teaching materials, explain the concepts:

- a) main river -
- b) retention -
- c) low flow -
- d) flood -
- e) water balance -

Task 3. Complete the table (data from the topographic map)

The source of the river and the height above sea level	
Estuary of river and the height above sea level	
The length of the river	
Main river basin	
Cities through which it flows	
Tributaries	
Reservoirs on the river	

Task 4 List the economic and landscape functions of rivers

- a)
- b)
- c)
- d)

Task 5 Locate a river on the map and follow these instructions:

- a) mark with X the site of measurements on the map
- b) define the direction in which it flows and mark with an arrow on the obtained fragment of the topographic map
- c) mark the source of the river (S) and the estuary (E) on the map
- d) identify to which main river, the river basin belongs (use the tourist map)
- e) determine the order of the tributary of the studied river

Task 6 What are the functions of riparian vegetation?

- a)
- b)
- c)
- d)

Task 7 Based on your observations and atlases or plant identification keys, complete the list. You may use national plant identification key or English one available at: <http://www.worldfloraonline.org/>

LIST OF IDENTIFIED PLANTS

- a)
- b)
- c)
- d)
- e)
- f)

Task 8 Make photographic documentation of the riparian vegetation.

Task 9 List the causes and effects of floods.

The causes of the flood	The effects of the flood

Task 10 List flood prevention measures.

-
-
-
-
-
-
-
-
-
-



BRINGING RESEARCH
INTO THE CLASSROOM

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