

# Teachers-guide to the eLearning module History of the Baltic Sea

This teacher guide is intended to accompany the eLearning module entitled History of the Baltic Sea accessed via the websites [www.balticweblab.eu/](http://www.balticweblab.eu/) or <http://vma.ku.lt/weblabnew/>. The module presents scientific concepts used to explore geologic and oceanographic changes that took place in the Baltic Sea area during the past 15 000 years.

Second edition, October 2013 by Pia Romare, Lund University, Sweden and South Baltic WebLab, together with Hilke Heinks, Bismarckschule, Hannover, Germany.

## Content

<b>1. AN ELEARNING MODULE ABOUT THE HISTORY OF THE BALTIC SEA.....</b>	<b>2</b>
1.1 OBJECTS AND TARGET GROUP.....	2
1.2 A BRIEF INTRODUCTION TO THE STRUCTURE OF THE MODULE .....	2
<b>2. HISTORY OF THE BALTIC SEA – A GEOLOGICAL PERSPECTIVE.....</b>	<b>3</b>
2.1 WHY CARE? .....	3
2.2 GEOLOGICAL PROCESSES .....	3
2.3 THE DOCUMENTATION IN THE SEDIMENT .....	3
2.4 THE GEOLOGICAL HISTORY OF THE BALTIC SEA .....	3
<b>3. METHODS AND EXERCISES.....</b>	<b>4</b>
3.1 SCIENTISTS READ THE SEDIMENTS .....	4
3.2 STUDENTS READ THE SEDIMENTS – EXERCISES .....	4
<b>4. HOW TO USE THE MODULE.....</b>	<b>5</b>
<b>5. GUIDE FOR USAGE IN CLASS.....</b>	<b>6</b>
5.1 FIRST DOUBLE LESSON (90 MINUTES) .....	6
<i>Introductions in class .....</i>	<i>6</i>
<i>Introduction and background knowledge (individually) .....</i>	<i>6</i>
<i>Preparation for three labs.....</i>	<i>7</i>
<i>Working in the labs .....</i>	<i>7</i>
5.2 SECOND DOUBLE LESSON (90 MINUTES) .....	8
<i>Presentations and discussion.....</i>	<i>8</i>
<i>What did you learn - quiz .....</i>	<i>8</i>
<i>Discussion.....</i>	<i>8</i>
<i>History as we know it today .....</i>	<i>9</i>
<i>Simulating the future .....</i>	<i>9</i>
<b>6. MODULE ACKNOWLEDGEMENT .....</b>	<b>9</b>
<b>7. OTHER MODULES FROM SOUTH BALTIC WEBLAB.....</b>	<b>9</b>

# 1. An eLearning module about the history of the Baltic Sea

The eLearning module entitled “History of the Baltic Sea” is one of five modules, on the Baltic Sea, produced within the EU project South Baltic WebLab ([www.balticweblab.eu](http://www.balticweblab.eu)).

## 1.1 Objects and target group

In the module the students will experience how they – as marine scientists – extract some geological facts from the Baltic Sea itself. After working with this module the students should have gained a better understanding of how the Baltic Sea developed and a better idea of how scientists work. Hopefully it will also raise their interest in marine sciences.

- Target age group: 14 – 19 years.
- Subjects in which the module may be used: Sciences, Biology, Geography, and Bilingual classes.
- Context in which the module could be included:
  - When learning about the environment of the Baltic Sea.
  - When learning about the history of the earth.
  - When learning about ice ages and the subsequent changes in our environment and landscapes.
  - When learning about what it is like to work as a researcher within science.

## 1.2 A brief introduction to the structure of the module

In this eLearning module the students will experience the following:

- In an introductory story they will dive down 20 metres below the surface of the Baltic Sea to see trunks and roots from a pine forest that grew there more than 10 000 years ago!
- Next they will be provided with some learning content about geological processes that formed the Baltic Sea and how marine scientist use historical archives to study its geological history.
- They will be sent on a cruise, shown how to find a suitable sampling site and which equipment can be used to sample sediments from the bottom of the Baltic Sea. A sediment core will be sampled and cut into sections.
- The students will start their work with opening the core sections and deciding how many historical stages it represents.
- They will then take part in analysing sediment samples from each stage in three different laboratories:
  - Analyse samples in the Sediment lab (structure, grain size, organic content)
  - Analyse samples in the Palaeontology lab (microfossils)
  - Analyse samples in the Dating lab
- At the end of each lab there will be an evaluation and they will draw some first conclusions.
- In a quiz they will need to put together all the given background facts (about geological processes, sediments, microfossils and dating methods) with their own results in order to reconstruct the history of their sampling site.
- At the end of the module they will get a short summary of the history of the Baltic Sea as scientists know it today.
- Finally, they will have an option to continue and hypothesise about the future.

## 2. History of the Baltic Sea – a geological perspective

### 2.1 Why care?

Why care about the geological and environmental history of the Baltic Sea? The Baltic Sea is highly sensitive to the environmental impacts of human activities in its catchment area which is home to some 85 million people. Today scientists struggle to understand the causes and effects of the environmental changes that have occurred in the Baltic Sea during the last decades. Are these changes caused by human activities only or are they a result of natural variations in the environment? What will happen in the future? To find out about this, we need to know about the past.

### 2.2 Geological processes

Gigantic geological processes are involved in shaping and reshaping the Baltic Sea region. Some of the processes involved are climate changes, sea level changes, erosion and crustal movements (e.g. land uplift). Scientists now know that 20 000 years ago, during a cool period, a 3 000 m thick glacier covered northern Europe. When the climate got warmer the ice sheet started melting and gradually disappeared, leaving behind a cold and lifeless ice lake in the south Baltic area. In the course of time – because of the processes mentioned above – the ice lake changed into a sea, then back to a lake, and today we have the brackish Baltic Sea. One interesting question is how scientists found out about this.

Explanations:

Crustal movements and land uplift: During glaciation the load from the ice sheet presses the earth's crust beneath and in front of a glacier down. When the ice sheets melt and the weight lifts, former depressed areas start to bounce back – this is also called land uplift.

### 2.3 The documentation in the sediment

Nature documents geological and environmental changes in its own way – in the sediment! Sedimentation of mineral particles and dead organisms form layers in undisturbed, deep areas of lakes and oceans. At the very bottom of the sediment of the Baltic Sea we find the oldest layers that were laid down when the ice started melting. Thus, the sediment is like an archive we may use to look into historical changes, and to learn more about what it was like in the Baltic Sea area thousands of years ago.

### 2.4 The geological history of the Baltic Sea

In this eLearning module the students will extract the facts that – together with some background information – will help them to solve a final quiz and reconstruct the history of their sampling site in the Baltic Sea.

The full story – as we know it today – will be summarized at the end of the module. That is, when the students put their results in the context of other, similar investigations, they will learn more about the four stages in the development of the Baltic Sea and how the change from one stage to another came about.

## 3. Methods and exercises

### 3.1 Scientists read the sediments

Scientists know how to “read” the sediments, and by using a variety of methods they extract geological facts from the sampled sediment core.

*In the sediment laboratory* the scientist first look at the colour and structure of the sediment core to establish at what depth historical changes are visible – that is, at what depth another unit replaces the previous one. Some structures reveal if there have been periods when the bottom water did not contain dissolved oxygen, other structures and also grain size may tell if a glacier was near by or not. Scientists also look for the presence of organic carbon in old sediments as a sign of past life. The amount of organic carbon also reflects the nutrient status of the waters.

*In the palaeontology laboratory* the scientist study microfossils such as the remains of microscopic plankton algae called diatoms. The species composition of diatoms directly reflects changes in the environment of the surface water layer, for example if it changed from a marine to a fresh water environment.

Explanation: palaeontology means the scientific study of prehistoric life and it includes the study of fossils.

*In the dating laboratory* the scientist use different dating-methods to establish the age of sediment layers, and thus, the timing of historical changes.

### 3.2 Students read the sediments – exercises


In the three labs it is the students’ job to:

- Look at all core sections and decide how many historical stages (units) the core represents.
- Sample the sediment and construct a stratigraphy:
  - Classify each unit by colour and structure,
  - Sample and analyse sediment grain size
  - Sample and send away samples for analysis of total organic content (TOC). Create a TOC diagram from the data they receive from the analysis.
- Identify and count diatoms from a microscope slide. Divide the diatoms into groups that characterize different water conditions – fresh, brackish and marine.
- Sample organic material in the form of shells and send away for C-14 dating. Calculate the age at the different depths from the C-14/C-12 ratios.
- Date a varved sediment by using the method of varve cross correlation.
- Compare the geological age data with known historical events.

## 4. How to use the module


In order to access the modules you will need to have a Flash Player plugin installed in your web browser. Speakers or headphones are recommended.

Estimated module duration is 2.5 hours or 2 x 90 minutes in class.



The module is produced in English. Subtitles are provided in German, Polish, Lithuanian, Swedish and Danish. Note that when you switch to another language you may have to reload the first scene by clicking on  in the bottom left corner. Audio is provided in the English version only.

The module and the quiz connected to the module will both be played on Moodle, a Learning Management System. To answer the quiz, the students need to remain logged in once they have entered the Moodle site - <http://vma.ku.lt/weblabnew/>. You find the login at the right side of this site and you log in with your username and password. There is also a link to set up a new account or request forgotten details of your existing one.

Once you are logged in for the first time, you - as a teacher - must create your profile in Weblabnew. Thereafter you have to send an e-mail to vma@ku.lt letting them know that you are a teacher requesting a teacher role in WebLab. In the teacher role you may download documents with solutions and you will be able to see all the results of the quiz, the answers students chose. You can see if a student has made single or several attempts and you will get a report with the results.

Click on the module to start it. Once the modules start, press <F11> on Windows OS or click on the two opposite arrows  situated in the upper right corner of your browsers window on Mac OS for a larger view.

Two more hints before you start working on the module:

- Use the little steering wheel  in the top left corner to access the table of contents for each module.
- There is also a [glossary](#) on Moodle for you to look up unknown terms – you may reach it directly from the module by clicking on the icon  to the right of the steering wheel.

You will find more hints in the usage guide within the module (look under table of contents). The usage guide explains all symbols used on the module screen.

As a teacher you may download a short version guide on how to use the module in class “Summary” (see the section “Guide for usage in class” below).

If you want extra summaries or help with preparing worksheets you may download the following documents from the projects website [www.balticweblab.eu/](http://www.balticweblab.eu/). (for further details on how you may use the documents, see the section “Guide for usage in class” below):

- The table “Table on labs”
- Worksheet Protocol

## 5. Guide for usage in class

See also the table “Summary” where we have outlined the time structure of two 90 minutes classes.

### 5.1 First double lesson (90 minutes)

In the first double lesson you will show a video and introduce the subject. The students will go through the rest of the introduction individually. The students will be divided up into three groups. First all groups will be introduced into the lab work together, then each group will continue to do the analysis needed in their lab.

#### **For the first double lesson you may use the following documents:**

Table on labs

Protocol – one for each student

#### **Introductions in class**

We suggest that you start in class by showing the video “The sunken forest” – which you will find as the second scene of the introduction.

After the video you may ask for reasons why there are pine trees in the Baltic Sea and why it is in general important to find out something about its history (expected answers: to find out about the consequences of climate change, to predict what might happen in the future,...)

Before the students start to watch the rest of the introduction in the module individually you may ask them to ponder on the question how they – as scientists- can find out about what happened in the past. The question is: Where are the clues?

Students’ hypotheses:

- sediments
- DNA
- old bottom water
- bedrock

#### **Introduction and background knowledge (individually)**

Tell the students that they shall go through the introduction individually – but that they may skip the video in scene 2 since you have already watched it together.

In the third scene “Geological history” the students are invited to join a cruise to find out more about what happened in the past in the Baltic Sea.

Note, however, that important background facts are also presented in this scene. Here we present some of the processes that have formed and still form the Baltic Sea region. Important to understand is:

1. The relationship between climate change (continental glaciers forming or melting) and global sea level change. When glaciers form, seawater becomes bound into ice and the global sea level decreases. When glaciers melt, the global sea level increases. Note that we are talking about the global sea level.
2. The relationship between glaciers and crustal movements (i.e. retreating glaciers is followed by land uplift, but also – in some areas – land sinking). Crustal movements may cause old waterways to close or new waterways to form.

Later in the module the students will come to realise, that through out history the Baltic Sea has seen drastic water level changes that have been caused by a combination of the two above mentioned processes.

Let the students continue to learn about marine snow, how sediments are built up (the sedimentation process) and how sediments are sampled.

In the scene “Sediment sampling” the students are out on the cruise and they “take part” in sampling a six metres long sediment core from a deep basin in the South Baltic Sea. At the end of the scene the sediment core is cut into sections and carried into the sediment laboratory in the ship.

### **Preparation for three labs**

Now it is time to divide the class into three groups – one group for each lab. It is important that all the students know what’s going on in all three labs. As a teacher you may download the table “Table on labs”. In this table we have prepared the information that you can share with the students using the white/blackboard.

### **Working in the labs**

All groups will start with the scene “Welcome In” and enter the sediment lab. They will see how the 1-metre sediment sections are split in half and examined. The students then have to puzzle the sections together into one 6-metres long core again and, by visually examining it, divide it into units. From the changes in the sediment colour and structure they will see that there must have been three major environmental shifts – thus, there will be four different units corresponding to four historical stages. The students analyse samples from these four units in three different labs in order to characterize each unit and understand when and why the shifts occurred.

The students will encounter three doors and there they will split up to work in either:

- The Sediment lab (1)
- The Palaeontology lab (2), or
- The Dating lab (3)

For their work the students may use the protocol.

Tell the student that they have to take notes and give them the following instructions:

Group 1: You are going to work in the sediment lab to find out about the colour and structure of the sediment, the grain size and finally about the TOC content. After working in the lab you should be able to present what you’ve done in the lab and present your results (in the protocol). Afterwards discuss your conclusions with your classmates by using the questions provided at the end of the lab.

Group 2: You are going to work in the palaeontology lab to identify different species of diatoms. After working in the lab you should be able to explain what diatoms are and why scientists use them. You should present what you’ve done in the lab and present your results (in the protocol) and discuss them.

Group 3: You are going to work in the dating lab to find out how old the different sediment units are. After working in the lab you should be able to explain the techniques you’ve learnt about and what you did in the lab. Present your results. Involve your classmates by using the last slide (comparing geology and history).

If one group finishes long before the others, you may advise them to continue in another lab.

## 5.2 Second double lesson (90 minutes)

In the second double lesson each group will present what they have done, their results and conclusions. All students will take notes and fill out their protocol. After that, you will prepare for the quiz, in which the students individually test what they have learnt. You then discuss “your” version of the history of the Baltic Sea in class. In the module the students may learn the whole history, as scientists know it today. Finally, you have the option to simulate the future land uplift of the Baltic Sea together.

### Presentations and discussion

After finishing the labs the three groups present their results (all groups), conclusions (groups 1 and 2) and a little about the techniques (group 3 may focus on the techniques).

Ask the students to note down important facts while listening (conclusions, methods they used or techniques they learnt about) and add new results to their protocol.

### What did you learn - quiz

Now it is time for the quiz in the scene “What did you learn?”. Going through the quiz will help the students to put all facts and conclusions together to get the story from this particular core/sampling site in the south Baltic Sea.

To prepare for the quiz you will go through the first four slides together in class to refresh some background knowledge. The fifth slide will introduce and link you to the quiz. The students may then do the quiz individually. Note that you all need to be logged in into Moodle to be able to do the quiz.

After logging in as a teacher you will have access to a report with the results of the quiz.

### Discussion

After the quiz is finished you can discuss the results in class. Remember that the information you have – except for some background data – is from a single sediment core taken at one single site in the South Baltic Sea. In the scene following the quiz the students will learn the full history – as scientists know it today.

Ask the students what kind of information they think they will need to get the full history of the Baltic Sea. Here are some questions they cannot answer based on one sediment core and the little background data presented in the module.

They do not have the answer to:

- why the (Baltic Ice) Lake turned into a sea 11 600 years ago? Where did the salt water enter and why?
- why water level dropped so much that pine trees could grow in what is now the Hanö Bay?
- why the pine forest was drowned again?
- why the Baltic is a brackish sea today?

What we know today about the history of the Baltic Sea we know from studies of marine and lake sediments, land formations and ice cores.



### History as we know it today

Let the students work with the scene “The History of the Baltic Sea” individually. In this scene we give a short summary of geological processes following the last ice age, and of the four historical stages and their environment.

Ask the students to note down what characterizes each stage and which processes are responsible for the changes from one stage to another.

### Simulating the future

History does not end today! Geological processes continue to form the history of the Baltic Sea. In some areas the land uplift will continue but eventually slow down. In the last scene of the module you and your students may hypothesise together about the future development of the Baltic Sea. Note that when looking into the future in the simulation here, you will only consider future land uplift. Changes in climate and in global sea level is not considered in the simulation model.

## 6. Module acknowledgement

The project South Baltic WebLab was partly funded by The South Baltic Programme.

**Facts were mainly provided by:** Lovisa Zillén (now at SGU), Svante Björck and Ian Snowball at the Department of Geology, Lund University, Sweden, Andrzej Witkowski at Szczecin University, Poland, Per Roos at the Technical University of Denmark (DTU), Denmark, and, Barbara Heintz and Sven Hille at Leibniz Institute for Baltic Sea Research Warnemünde, Germany.

**Credit also to:** T. Pässe, SGU, Sweden (The land uplift simulation), Project “Havsresan 2009”, Lund University, Sweden and M. Kjelstrup (Sunken forest video), H. Huth, Leibniz Institute for Baltic Sea Research Warnemünde, Germany (Marine snow video), The Rafter Radiocarbon Laboratory, New Zealand (Radiocarbon dating video).

## 7. Other modules from South Baltic WebLab

- Ecology of Baltic Sea Lagoons
- Coastal Dynamics
- Biogeochemical and physical changes in the Open Baltic Sea (on Eutrophication)
- Water Exchange Processes