iseca
INFORMATION SYSTEM ON THE EUTROPHICATION OF OUR COASTAL AREAS

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INTERREG IV A
"Investing in your future"
Crossborder cooperation programme
2007-2013 Part-financed by the European Union
(European Regional Development Fund)

Story-board
« Why does the sea foam? »

Technical tools needed:

- 1 computer
- Tools to vote (if you don't have the keypads and PowerVote software you can use numbered cards that participants raise in the air to give their opinion or…find your own way to make a voting system)
- Microscope (optional): study of phytoplankton species in a seawater sample

SEQUENCE 1: Welcome/Introduction

Slide 1: Introduction: watch some videos of foam, for instance:

- Foam in the Streets of Audresselles (North of France), 31th March 2010 www.youtube.com/watch?v=BqNu1pv40Hc *or*
- Video "When the sea foams" to be found in the Mediagallery section of the ISECA website: http://www.iseca.eu/en/index.php?option=com_photogallery&view=photogallery&layout=photogallery

Scientists would like to have more information on what you know and think about the foam phenomenon (public perception). Please help us by collecting all answers of your public today and send them to carolien.knockaert@vliz.be by using the form below.

Why does the sea foam?						
Date activity: Type of audience: Number of participants:						
Question number	YES (#)	NO (#)	No idea (#)	(#a) For Q10 and Q12	(#b) For Q10 and Q12	(#c) For Q10 and Q12
Q1						
Q2						
Q3						
Q4						
Q5						
Q6						
Q7						
Q8						
Q9						
Q10						
Q11						
Q12						

Slide 2:

Q1: Have you ever come across this phenomenon on the beach?

a. Yes
b. No

Slides 3-4-5-6:

Can you tell us what you think about this foam? To you:

Q2: Could it smell?

Q3: Does it look dirty?

Q4: Do you think it looks beautiful?

Q5: Could it pollute the water we swim in?

a. Yes
b. No
c. No idea

Slide 7:

Scum and foam, what is the difference?

Maybe you've already seen some scum coming from the sea: it is deposited on the beach when the sea is rough. The scum disappears immediately. But this isn't the case with the foam we're talking about, which can remain on the beach for several hours and even become green and then brown.

What is this foam phenomenon? What is its origin?

SEQUENCE 2: How can we explain this phenomenon?

First hypothesis: Slide 8

Q6: Could this be a natural phenomenon?

a. Yes
b. No
c. No idea

Second hypothesis: Slide 9

The foam on the beach may remind us of the foam we can observe when using products such as lye soap. So:

Q7: Do you think it is caused by detergents?

a. Yes
b. No
c. No idea

Third hypothesis: Slide 10

Climate change is often responsible for unexpected environmental effects.

Q8: Is this phenomenon due to climate change?

a. Yes
b. No
c. No idea

Fourth hypothesis: Slide 11

Q9: Is this phenomenon due to the overuse of fertilizers we use?

a. Yes
b. No
c. No idea

In order for us to understand this phenomenon, scientists explain where it comes from:

Slide 12:

Minerals are naturally present in seawater and are brought there by streams and rivers which carry away whatever comes from the land. There are many different mineral salts which contain important elements such as phosphorus, nitrogen and silica. These mineral salts (often called **nutrients**) are used for growth of different organisms such as plants but also macroscopic and microscopic algae. Microscopic algae (or short microalgae) are called **phytoplankton**. They are agents for **primary production**, a process that sustains the aquatic food web : besides the inorganic nutrients they need carbon dioxide and light from which simple sugars are made during a process called **photosynthesis**. In autumn and winter, when it frequently rains, rivers carry the mineral salts to the sea but during these months, less daylight is available so algal growth is limited. Correspondingly, the consumption of mineral salts is lower, leading to higher concentrations of these nutrients in the water.

Slide 13:

In spring, days are longer and there is more light available for photosynthesis. The concentration of phytoplankton increases greatly (the phytoplankton starts to **"bloom"**) but the concentration of the mineral salts in the water decreases during their consumption.

When we look at a drop of seawater through the microscope, we can see many different kinds of phytoplankton species.

There are nearly one hundred phytoplankton groups; they all differ in shape and function, for example:

- diatoms (cell wall made of silica);
- flagellates covered by calcareous plates (Coccolithophorids);
- flagellates forming colonies in an organic matrix: ***Phaeocystis*** species

But how can these organisms be responsible for the foam on the beach? Let's take a closer look at the planktonic algae, Phaeocystis…

Slide 14:

Phaeocystis

According to several scientific studies, *Phaeocystis globosa* is responsible for the foam.

The algae has several stages of development according its environment. Initially solitary, it proliferates and forms small to larger colonies (often linked to a nutrient-rich environment). Each colony is enveloped in a membrane and secretes mucus to protect themselves from grazing by other species. When *Phaeocystis* microalgae die (end of life cycle, often linked with the fact that nutrients aren't available anymore), the viscous film gets damaged and the colonies rip apart (lysis). When this is combined with big waves (windy or stormy conditions = rough sea surface) it can emulsify (like egg whites in "floating islands") and the remnants of the dying cells are whipped up forming the foam. At the stage of seeing the foam, *Phaeocystis* cells are already dead and the phytoplankton bloom is over…

SEQUENCE 3: Foam: a phenomenon increasing in both time and space

Slide 15:

Q10: The *Phaeocystis* bloom or the foam is a phenomenon observed during the month of …?

a. January ?
b. May ?
c. June ?

Slide 16:

Scientists who have been observing the foam for years tell us that it is increasing in both time and space. On occasions, the depth of the foam has reached even more than two meters! On the shores of the Eastern English Channel and the North Sea these phenomena are more common from March to June following the phytoplankton bloom.

Although it is a natural phenomenon, human activities may amplify the phenomenon: but which ones?

FIRST HYPOTHESIS

Slide 17:
Is the foam in any way due to the **detergents** we use?

Detergents contain phosphates which are used as water softeners in washing powders.
Because phosphates are highly soluble, it's difficult to extract them from dirty water. It seems ironically, but when our wastewater is treated in purification plants, the hardest things to remove are the products that we use to clean (washing powder, washing-up liquid, shampoos,…). The purified water is discharged into rivers and streams and through these rivers eventually transported to the sea.

Slide 18:
For many years now, reducing the quantity of phosphates in our washing powders is a topic of interest in research. New purification plants were constructed using physico-chemical treatments, reducing the amount of phosphates by 80 to 85%. As a result phosphate percentages in the sea dropped (around 50% fewer in the North Sea). We need to continue this work and improve our methods of purification. Even general public can contribute to a better water quality by using phosphate free washing powders and cleaning products.

SECOND HYPOTHESIS

Slide 19:
Global warming is the increase in average temperature observed on Earth. Since the beginning of the 20th century, the average temperature has risen by about 0.74°C. According to the IPPC (Intergovernmental Panel on Climate Change) it is very likely that this rising temperature is a result of climate change due to human activities (burning fossil fuels, deforestation, industrial and agricultural activity) leading to an increased concentration of greenhouse gases in the Earth's atmosphere.

Scientists monitoring the state of the sea (temperature, salinity,..) also measure an increase in the sea water temperature. Possible consequences are:

- Animals such as copepods (small zooplankton shrimp which feed on phytoplankton) move to new environments with a similar temperature compared to their own habitat. As a result the phytoplankton concentration increases at the original location and decreases in the new one. As a result some species may also develop more or less due to this zooplankton shift.
- When winter has been warm copepods may develop earlier. However the availability of light is lower than in spring resulting in low phytoplankton growth rates. Less food becomes available for the copepods which are in return food for bigger animals such as small fish, etc…
- It is also possible that the early development of the small zooplankton prevents the bloom of diatoms by eating them. As a result more nutrients become available for *Phaeocystis*, which escape from being grazed when living in colonies. Depending on the amount of nutrients, large *Phaeocystis* blooms appear and the bloom can be transported by winds and currents to other regions.

Conclusion: A link with climate change?
Life in the sea is in a state of equilibrium. Any change in sea surface temperature can have an impact on the circulation of the marine currents. Certain species are unable to withstand this current (e.g. phyto- and zooplankton species which float along by the current in the water) and migrate to other regions. This has an impact on higher species that feed on the phyto- and zooplankton. The overall result is an imbalance in the existing food web.
Global warming brings changes in the geographical distribution of a number of living creatures, with tropical species migrating to normally temperate regions and temperate species tending to migrate to normally cold regions. Eventually some species may even disappear…

Tackling climate change
For several years now the European Union has been committed to tackling climate change by taking action to curb greenhouse gas emissions in all its areas of activity trying to bid the following objectives: consuming less-polluting energy more efficiently, creating cleaner and more balanced transport options, making companies more

environmentally responsible without compromising their competitiveness, ensuring environmentally friendly land-use planning and agriculture and creating conditions conducive to research and innovation.

THIRD HYPOTHESIS

Slide 20:
We use **fertilizers** to enhance plant growth (gardening, farming, etc…) but when we use too much of them plants cannot fully absorb it all. The excess of fertilizers, composed of different elements such as nitrates and phosphates, are washed away from the soil and end up in the sea via the groundwater and the rivers.

Slide 21:
Phosphorus and nitrogen are essential for plant growth. The amount of phosphates is already reduced due to the lower use of them in agriculture and by efficient removal in detergents, but studies still have found an imbalance of nutrient discharge in the sea: there are too many nitrates in the water relative to the phosphates. This can lead to phytoplankton blooms and the development of harmful algal species (HAB). One of the solutions to this problem is to encourage environmentally friendly farming and reduce the amount of fertilizers (which contain nitrates) in our fields and gardens.

An excess of nutrients (such as nitrates and phosphates) is called eutrophication.

SEQUENCE 4: Is the foam a problem?

Slide 22:
Q11: Is the foam a problem?

a. Yes
b. No
c. No idea

Slide 23:
When *Phaeocystis* concentrations exceed critical levels, it can cause sudden major changes:

. The viscous *Phaeocystis* mucus accumulates in the gills of molluscs and fish, and prevents them in filtering the sea water and gives difficulties in breathing. Sometimes it can even kill them. Fortunately the foam is not toxic for humans.
. The *Phaeocystis* colonies are poorly eaten by zooplankton, and this disrupt that part of the food chain which ends up in fish, but stimulates that part of the food chain which is dominated by microbial activity. Hence, the development of *Phaeocystis* colonies can have a negative impact on fisheries.
. The proliferation of algae decreases the amount of light from penetrating the water and therefore upsets the growth of different plants living in the same habitat. This problem is more seen in lakes than in seas.
This has an impact on the food chain and eventually affects the entire ecosystem.
. Impact on economic activities such as fishing (the algae can clog fine-meshed nets and can even damage boat engines), shellfish farming, tourism and numerous other sectors…

SEQUENCE 5: You can do something about it!

Slide 24:
Q12: With everything that we've learned, which action(s) would you take? (more than one choice possible)

a. Reduce your use of detergents.
b. Eat products grown with less fertilizer.
c. Reduce your consumption of fossil energies.

Slide 25:
The preservation and the improvement of water quality in the marine environment is a highly motivating challenge. We must act now! Many of us are ready to do something to reduce our impact on the sea.

Remember: ***all our activities on the land have an impact on the sea!***

Slide 26:
ISECA is a european project on the topic of eutrophication of coastal waters in the North sea and the English Channel.

For decades, scientists from various institutions and research disciplines had been observing the algae development on the coastline individually with their own scientific tools.

Thanks to ISECA, their knowledge is now brought together in a single database in order to anticipate the phenomenon evolution and to inform the authorities and the stakeholders so they can take appropriate measures.

Educational activity created by Nausicaá as part of the INTERREG IV A 2MERS 'ISECA' PROJECT
Information System on the Eutrophication of our Coastal Areas

More information: www.ISECA.eu/en/