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Science and Global Education beyond the barriers of learning difficulties 2015-1-IT02-KA201-014774

Sheet 7

Man and carbon

Introduction

The carbon cycle is one of the great bio-geo-chemical cycles present on ,,earth. The properties of carbon as a chemical element make extremely flexible the possibility to form molecules and to react with other elements, to the extent that a whole chemical branch was born to investigate organic chemistry.

Carbon is also the element that characterises living creatures. Man, hence, intersecst constantly with the carbon cycle and with his actions modifies its course.

In this sheet, we face the issues on how man and human activity fit in this cycle. Are the human actions integrated in the process or they disrupt its course?

The study of carbon reflects the relatioship man-nature, even if this word is inexact. A science teacher, infact, should propose a different point of wiew, one that doesn't reflect the vision created by the main monotheistic religions that conditioned man to believe to be detached from nature, We should recover a more inclusive thinking that can bring man to be part of the natural process again: a vision that helps man not to create any imbalance, like the C02 increase in the athmosphere, which directly conditions all living creature's life quality.

The transition between producing energy from fossile sources to producing it from renewable ones is an example of how one action

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can affect the carbon cycle in an exceptional way, reconcilying it to timeframes when the earth system was more balanced.

Class activity

Materials
- skein of wools of different colours;
- skein of thicker wool, red ;
- scissor ;
- A4 white paper sheets;
- A4 green paper sheets.

Carrying out

-Move the desks within the classroom to create five desk-islands. These islands will be the carbon "tanks": Athmosphere, Hydrosphere, Lithosphere, Biosphere(animals), Biosphere (plants).
- Write the name of each tank on paper and place it on the desks.
- Define, with the students, the carbon tanks. Specifically get them to think on the fact that there is no place where carbon is stationary, but there are stations where carbon transits: Carbon shifts from one tank to the other, changing form and creating so the carbon cycle.

Step 1 – Let's represent the carbon cycle
- Ask the students to think to some natural processes that connect one tank to another by transferring carbon. Each time they find a link, connect the two tanks with some wool thread and attach a sign

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that explains the reason of the link. Focus on the natural processes only, avoiding the links generated by human activity.
For example:
Processes that don't include the implication of living creatures (grey wool): lithosphere-hydrosphere (minerals leaching); hydrosphere-lithosphere (stalactite and stalagmite formation); lithosfere-athmosphere (volcanic activity).
Decomposition processes (green wool): plants-lithosphere (humus formation); animals-lithosphere (dead animals decomposition and feces); animals-athmosphere (methane production by rotting process)
Processes that involve living creatures (black wool). Athmosphere-plants (fotosinthesis); hydrosphere-animals (shell formation); plants-animals (animals eat the plants and viceversa).

The identification process is free. But it's important that, at the end of phase 1, each tank is connected at least once with the others and that there are processes coming in and out of each tank .

Step 2 – Let's introduce man
- Think, with the students, on what has been created in step 1, where is man placed?: He is part of the "animals" tank – proceed similarly to step 1, ask the students to connect the different tanks on the basis of processes resulted from human activity; also, indicate the negative consequences.

Examples: fossile fuel extraction, from lithosphere to animals (the extraction time is faster than the time of formation); combustion (it's a use reserved only to humans), from animals to athmosphere with production of C02 (green house effect rising and consequent

global warming); Shifting of methane from the lithosphere to the athmosphere due to leaks produced by drilling (rising of the green house effect); Leaks of oil into the oceans, from lithosphere to hydrosphere (water and shores pollution); deforestation (decrease of the plants action in removing C02 from the athmosphere); intensification of methane production due to intensive farming, from animals to athmosphere withe rise of gas (greenhouse effect's increment).

-Identify, also, the indirect consequences of carbon shifting Examples: oceans acidification, from athmosphere to hydrosphere (change of marine animals living condition); raise of polluting elements in the lithosphere, athmosphere-hydrosphere (problems for animal's health, including man).

Even in this case, each identified element becomes a wool thread, that connects the tanks concerned, where we can attach a sign that indicates the represented process.

Step 3 – Let's find some solutions.
Once highlighted how human actions are responsible for strong, negative impacts on the carbon cycle, let's try to find some solutions.

- analyse each single issue and think about the solutions. – write each solution on a green sheet and attach it to the red wool thread, already laid out.

At the the end of the game, it will be eviden that all, or almost all, actions taken to solve the problems created by human activity will

take the road to decarbonisation. None of these actions involves consequences of deprivation for man, like a reduction in energy, food or prosperity; it represents instead, a different way to face the issue on how we see the world and what is the man's place in the environement . Generally all solutions will require man to be integrated in the cycle and focused on preserving the natural processes.

Suggestions (storytelling/gamification)

The three steps of this activity can be all introduced as a challenge where the students must improvise themselves as inventors (singularly or as a group). The inventors have a mission: They will have to assemble a working system in the shortest time. Afterwords we can carry out a competition regarding the different performances of the systems.

transversality suggestions

CHEMISTRY: The cycle can be represented again focusing on human activities related to the chemistry field, that can be included in the carbon shifting dynamics, from petrochemistry to Green chemistry.

HISTORY: The carbon cycle can be reconstructed in a dynamic way following a precise timeline, starting from before mankind appearance on earth (step 1) and analyzing some key-moments of the human evolution (hypothetical stops: the advent of agricolture; year 0; the discovery of America; the industrial revolution).

PHILOSOPHY: Talk about the vision of the world and the position of man, in respect of nature and the environement, over the ages.

LAW: the evolution of environemental laws in the XX and XXI centuries in the key of decarbonification and environemental impacts.

Websearch

Euopean commission – Press Release

Interesting information document fom the energy Union. A european vision of the energy issue. Specifically, we can find the european direction toward decarbonisation of: economy, energy and transportation.
http://europa.eu/rapid/press-release_MEMO-15-4485_en.htm

The Carbon cycle(VIDEO)

A video, produced by Ted-Ed, explaining the functioning of the carbon cycle with an overall wiew linked to human activities.
https://www.youtube.com/watch?v=A4cPmHGegKI

Berkley University research center

Interdepartmental laboratory aimed to research on how to accelerate the transition toward a global carbon-neutral energy system.
http://carboncycle2.lbl.gov/about/

Interactive carbon cycle

Waikato University interactive website that includes videos and multimedia content regarding the carbon cycle and its numerous parts.
http://sciencelearn.org.nz/Contexts/The-Ocean-in-Action/Sci-Media/Interactive/Carbon-cycle