1.7	CO_2-Friendly House

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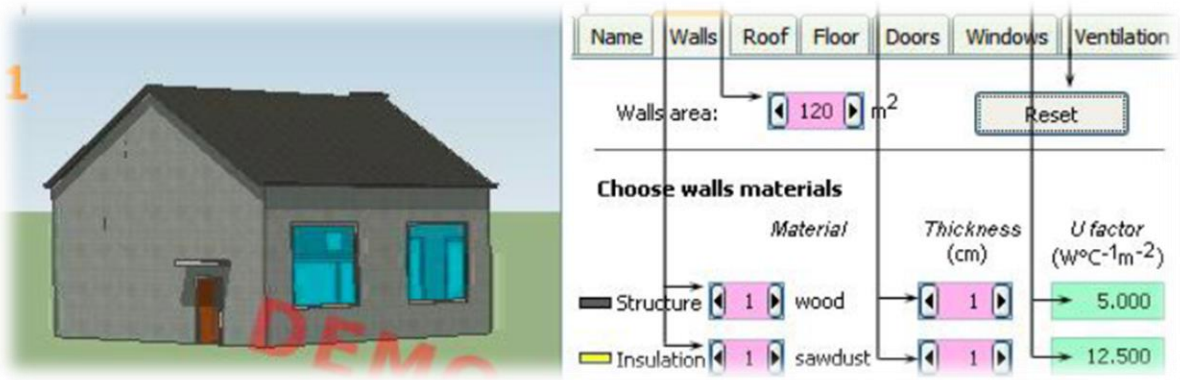

Short Description:

about energy, CO_2 and sustainability

Aims:

To introduce:

- *design-based learning*
- *specific knowledge on energy, CO_2 and climate*
- *working in expert groups*

Fostered Skills:

From a student point of view

General science skills

- I can write correct hypotheses.
- I can design, plan and perform experiments to test hypotheses.
- I can organize, visualize and interpret data
- I can construct a dynamic model.

General social and presentation skills

- I can collaborate well with peers (e.g. master themes like division of work, making decisions, constructing a common product etc.).
- I can plan and execute my own learning process.
- I can reflect on my current knowledge and learning goals.
- I can hold a presentation for a large group (e.g. my own class).
- I can write an individual report.

General science concepts

Physics (thermodynamics)

- I can identify and describe the three main types of heat transfer: conduction (heat transfer by contact), convection (heat transfer by the movement of a heated fluid, liquid or gas), radiation (heat transfer from electromagnetic radiations (light) through transparent space).
- I can explain that light (electromagnetic radiations) heats materials.
- I can apply the concept of U-value (measured in W/m2°C) of a building element (e.g. wall) in which the heat transfer by conduction is calculated for a combination of layers of various materials.
- I can estimate the heat transfer coefficient of a building (measured in W/°C) by summing the contributions from all the building elements. I can use this concept in order: 1- to characterize the thermal efficiency of the complete building (independently from the climate) 2- to compare the heat transfer coefficient of all kind of building elements (e.g., walls or ventilation system) whatever the heat transfer mode (conduction or convection).

Physics (electricity)

- I can explain the concept of power (P) and work with the formulae: P = E / t , E = P t.
- I can explain the concept of efficiency (η) and work with the formula:η = Puseful / Ptotal = Euseful / Etotal.
- I can convert from Joule (J) to kilowatt hour (kWh).

Connection to the curriculum:

To investigate the overlap of reference material to be included in the mission with learning and instruction specifications for and needs of the target group of students who will use SCY-Lab (age range of 12-18), we conducted an analysis of national curricula. The topic of reducing domestic CO_2 emissions revealed a significant compatibility with various domains and learning goals across national curricula of lower and upper secondary education (e.g., physics, biology, chemistry, mathematics). The topic of reducing domestic CO_2 emissions also offered the opportunity to organize an innovative science curriculum in an inquiry modelling setting and orchestrate a wide array of collaborative activities to be undertaken by students under the support of tools and scaffolds embedded in SCY-Lab.

The analysis of curricula in the different countries involved (Cyprus, Estonia, France, the Netherlands and Norway) revealed that this mission mostly fits with these criteria. We identified 3 main limitations:
- The mission is best suited for students in the upper level of our general target group (age 16-18).
- The scientific concepts concern mostly physics and in a lesser extent biology and mathematics.
- This topic is poorly linked to the Estonian curriculum.

Implementation of the Demonstrator:

In parentheses the ISE terminology.

1. Orientation *(Orientation and Asking Questions)*
   The project begins with a plenary session in which the teacher contextualizes the whole project by explaining the mission the students will engage in. Students can ask questions,

discuss content, and explore how to structure the work. Students collect what they already know about the topic, identify learning goals, and plan the learning process.

2. Conceptualization *(Orientation and Asking Questions)*
   Students try to identify the different concepts involved in the mission. Their efforts result in a theoretical model (e.g., a concept map) that links these elements together and serves as basis for generating hypotheses they could investigate. Students come back to refine their conceptual models in the course of the scenario.
3. Design *(Hypothesis generation and design)*
   Students design an artifact based on the conceptual model
4. Build *(Planning and Investigation)*
   Students actually build a real or simulated artifact.
5. Experiment *(Planning and investigation)*
   Students design and conduct experiments with the respective artifact(s) they have designed.
6. Evaluation *(Analysis and interpretation)*
   Students evaluate the data collected against their hypotheses and use the outcomes of this comparison to refine their conceptual models and artifacts.
7. Reflection *(Conclusion and Evaluation)*
   Students evaluate whether they reached the mission goals and learning goals, and explain reasons for possible deviations. They discuss how (or whether) the gradual increase in understanding caused them to modify project goals or if other factors such as time assigned, tools, limitations, and lack of good information led them to reconsider their ambitions. Students also reflect on their learning process and discuss what they would have done differently
8. Reporting *(Conclusion and Evaluation)*
   Students summarize their accomplishments in a written report and prepare a presentation to the class and the teacher.

Domain: physics, chemistry, mathematics	**Big Idea of Science:** 1;4;5;6	**Age group:** 15-18	**Time needed:** The duration of the mission is approximately 20 hours, but depending on the level of the work it can be done in more or less hours.
Languages available: Dutch, French, English	**Equipment needed** Computer for each student.	**Involved actors** Teachers	**Used eTool and link:** Scy house simulation; www.SCY-net.eu

Quality Characteristics of the Demonstrator

Characteristic I

how Demonstrator follows an **inquiry based approach**

This is quite clear from the content as the learning activities follow the design-inquiry cycle. The scenario demonstrates the way the inquiry activities can be combined in multiple sequences.

Characteristic II
how Demonstrator integrates **eLearning element**

The eLearning elements in the scenario are the simulation of the house and the tools for creating concept maps and pans for experimentation. Also google sketchup is used as tool to create the designs.

Characteristic III
how Demonstrator follows a **Big Idea of Science**

In one of the simulations, an energy balance is computed demonstrating the big idea of conservation of energy.

Characteristic IV
how Demonstrator is connected to a **real world problem**

CO_2-emission is a known problem. Designing artefacts, including houses, that reduce the total emission of CO_2 is relevant in teaching and learning about global warming and energy conservation.

Experiences with the Demonstrator?

yes
Within the SCY project. Results are reported in: http://www.scy-net.eu/static/deliverables/SCY%20DIX.3.pdf