Your ideal (and sustainable) home. Dream about where you would like to live, what your ideal home would be like and how this ideal home could be more sustainable.

Collect data thanks to the board and its embedded sensors - 1/2

Dream about what your ideal home would be. Which features? How you would distribute the space in it? And if you had to make it more energy-efficient, how would you do it?

As a first step, it would be better if students would draw their designs. Afterwards, a classroom discussion about their designs could be undertaken, putting a special emphasis on making them more energy efficient. So teachers/educators should guide students in the dialogue to identify different sources of energy (e.g. sun, heating systems...) and what they could do to not waste these energies. The aim of this dialogue would be to focus on the materials used to build the house, as they have a key role in saving energy. Then, students would be invited to reflect again on their own designs and think about which materials do help to save energy (i.e. isolate the heat) and which materials do not help to save energy (i.e. act as a heat conductor) and why students think they are thermal isolators or conductors. Some examples can be provided, such as glass, brick/chalk, metal, plastic, wood... In the end, the teacher would invite students to think about how they could better study if the material is isolator or conductor, introducing the need to use a data-gathering device.

Now that you have identified the relevance of the materials for building and you have to build the first design of your ideal home, we will test how these materials behave and which of them would make your home more energy-efficient. For this, we will need to try how different materials allow or not the transference of heat. Remember that a home in which there is a big heat transference cannot be considered energy efficient: you need to keep the inside isolated from the outside as possible.

Think about which evidences will you need to collect to study if a material is a heat conductor or an isolator. What would you measure? Which other conditions may affect the measure? How would you design an experiment so the heat conductor/isolating capacity of material could be tested?

It is important to guide the students so they can design a proper experiment to collect data about the isolating capacity of different materials provided. Other factors that affect the measure could also be considered here, such as material thickness, time of exposure to the heat, climate... The experiment could be carried out in two different approaches: in summer, where we need to isolate our houses from the sun as a source of heat; or in winter, where we need to isolate our houses so the heat produced by the heating systems is not lost to the environment. Both approaches are valid, but one might be more relevant than the other considering the climate in which the students live.

Collect data thanks to the board and its embedded sensors - 2/2

This part is designed to connect to the physics model of particles (matter), in which heat is a way of energy transfer, related to the movement of particles. It is important to identify where the energy source is (sun, heating system) and the transference process (from the source). Two important misconceptions (https://journals.flvc.org/cee/article/download/87720/84517/) in this part are that **isolating materials** "heat" (i.e. a wool jumper "heats" us) and that the **cool also "travels"** (i.e. we can feel how the "cool" enters through the window if we open it during winter). It is important for the teachers to identify if students' are holding these misconceptions and offer alternative experiments to build on these ideas (i.e. explore what would happen if we put an ice surrounded by wool. Would it melt faster?).

Display the data to get the needed information

In the previous section, we built a sensor and design an experiment to test the energy efficiency of our homes. However, in order to assess this efficiency, we would need to gather this information and assess the materials used.
To show the temperature that is measuring the sensor, the first solution could be to use the LED display. Another possibility is to program the board so this information is stored and transferred to a computer in a CSV format afterwards.
A function to interrogate the temperature sensor in the board can be used.

Analyse the data and learn from them

Instant temperature data have allowed us to explore the heating conduction or isolating capacity of different materials. In this part, we will analyse this data and try to imagine how could we explain these different behaviours and use that knowledge to build our ideal home.

If students have decided to analyse the data over a certain period of time, spreadsheet software would be required. In that case, the data gathered would be needed to be retrieved from the board. Otherwise, they can take notes about the temperature of the sensor displayed on the LED. After the data analysis, students should define isolators as materials that help to keep or maintain the temperature on the inside of the home, and a conductor as a material that contributes to modifying the temperature inside the home. It is important in this part that students are able to relate the temperature gathered with the energy the air particles have (which can be described as the movement of the particles). And how this particle movement can be more or less transferred from one particle to another and from the outside to the inside and vice-versa. That is, students should be able to use the particle model to explain heat transferences, so science ideas are developed as well as technical ones.

CONTACT - CARME GRIMALT-ÁLVARO - UNIVERSITAT ROVIRA I VIRGILI - SPAIN

carme.grimalt@lets-steam.eu