

# House Insulation – teacher guide

## Abstract

House insulation and energy consumption from inadequate insulation are common issues in our societies. In this activity, we ask students to examine two different factors that might contribute to different energy consumption from house heating in two houses that appear to be the same. Finally, based on the outcomes of the investigation we invite students to construct their own model of a house with good insulation and discuss practices that building engineers and architects use when they design houses.



The students are asked to consider the following factors during their investigation:

- Using different materials to construct a house,
- Using different insulation techniques,
- Combination of the aforementioned.

Furthermore, the students are asked to use their mathematical knowledge in order to be able to calculate which one of the solutions proposed in Question 2 is the best. Additionally, the students are asked to prepare graphs based on the evidence they are collecting, and analyze the graphs. Finally, an additional goal of these activities is to help students develop experimental skills, design fair experiments, and argumentation.

**Discipline:** Physics with links to Mathematics

**Duration:** 90 minutes

**Target Group:**

**Age range:** 12-15

WoW context: building engineers and architects

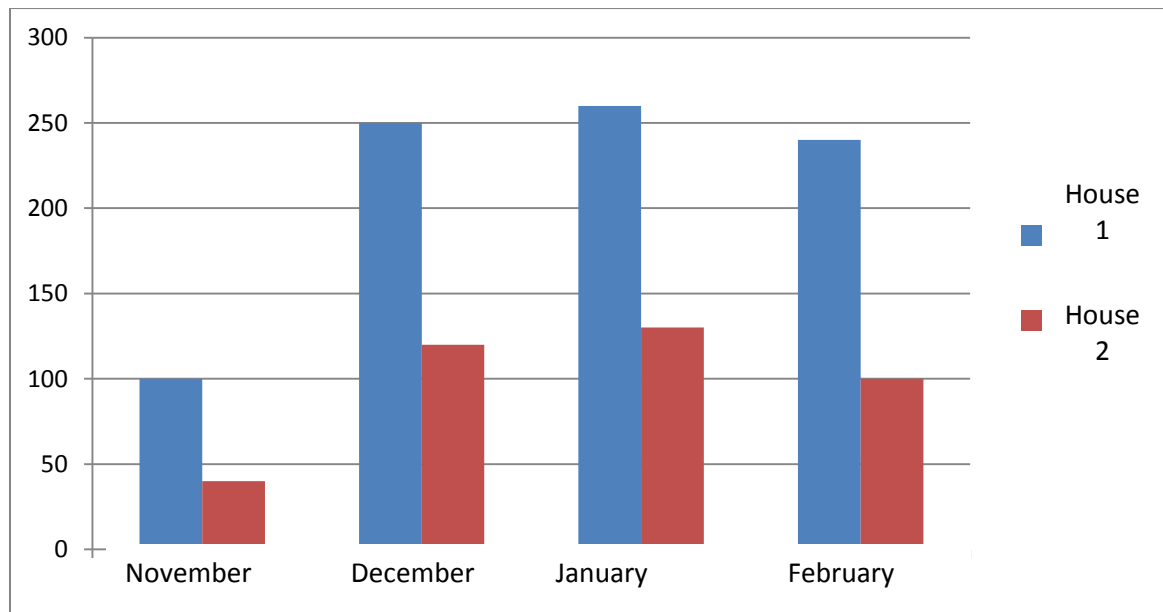
Students' worksheet presents the following scenario:

Two neighbours, Antony and Alex, found out that they pay 390 and 850 Euros respectively for house heating over the period November- February (the graph below presents the cost per month for each one of the houses). Their houses are built in the same area, they are the same (in terms of architecture and area they cover), they get the same hours of sun, and the temperature inside is the same around the clock. Both houses use the same type of heating.

Alex and Antony are asked to provide their hypotheses about what is causing these differences on the amount the two neighbours are paying for heating. We expect them to suggest, among others the following:

(a) the type of material that was used to build the house has an impact, and (b) the type of insulation has an impact.

The teacher is taking notes on the different kind of hypotheses, and is asking students to suggest ways to explore these hypotheses, and suggest examples of jobs that would help with this issue.



Graph 1: Cost per house per month (House 1:Alex, House 2: Antony)

## Lesson Plan Example

### 1st Lesson

10 minutes

The teacher presents the problem to the class along with the graph that shows the cost per month for each one of the houses, and asks them to hypothesize about possible causes of the different costs. The hypotheses are discussed, and the students are asked to propose what kind of professions are linked to this topic. Then the students are asked to suggest ways to explore their hypotheses and set up experiments. The teacher is expected to guide the students towards hypotheses that can be explored experimentally, e.g. the material or the insulation might have an impact.

30 minutes

The students work in their groups in order to propose experiments that can be done with materials they are provided (e.g. metal, Styrofoam and glass containers) and can help them collect evidence and explain their data for their hypotheses. The role of the teacher during this process is to support groups and at the end of the activity to discuss the outcomes during a whole classroom discussion. More specifically, the teacher is expected to discuss the control of variables in the experiments, how we collect data, and also discuss

errors in data collection.

5 minutes      Whole group discussion on the outcomes of exploring the two hypotheses experimentally.

## 2nd Lesson

5 minutes      The students are arranged in groups of 3-4 people and discuss the findings from the previous experiments and how these link to the two hypotheses.

20 minutes      The students work in their groups trying to provide answers for questions 1 and 2. The discussion takes place both in the groups and during a whole classroom discussion at the end of the lesson.

20 minutes      The students work in groups to construct a model of a house with good insulation, and to examine their model's insulation compared to that of other groups. Additionally, the students are asked to think about the practices that architects and building engineers use when they construct houses in order to make them energy efficient.

## Available Materials

- worksheets
- materials for experiments (see worksheets)
- materials for house model (students can bring their own materials)

## Teaching notes

This activity can be used in order to engage students in scientific investigations, designing experiments and argumentation. The teachers can offer different kind of scaffolding to designing experiments based on the level of the students. Specifically, if the students do not have expertise in designing fair experiments the teacher can discuss the proposed experiments and explain why and how it is important to control variables in fair experiment. Additionally, a building engineer or an architect can be invited to the class to discuss the practices they are using when designing buildings.

Finally, technology can be used to collect and graph the data (interfaces).

*The original version of this PoM was designed by Yiannis Karmiotis (Physics Teacher) and was adapted by the Mascil Cyprus group.*