



Scheme of Work-8

The Monte Rosa Mountain Hut

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Overall learning objectives

- Gather and display data and interpret it to explain energy transfer and efficiency.
- Apply concepts of energy transfer and conservation to building design.
- Gather data to monitor effectiveness of solutions and evaluate impact.
- Design solutions to meet various characteristics of a brief and judge the extent to which a design solution meets the required brief.

Overall learning outcomes

- To be able to explain scientifically how energy is transferred from a building to the surroundings.
- To suggest how energy loss can be prevented.
- To investigate this and draw conclusions.

Curriculum learning objectives

Students should be able to:

Maths

- Apply suitable mathematics accurately within the classroom and beyond.
- Communicate mathematics effectively.
- Select appropriate mathematical tools and methods, including ICT.

Science

- Use scientific ideas and models to explain phenomena and develop them creatively to generate and test theories.
- Critically analyse and evaluate evidence from observations and experiments.
- Explain how energy can be transferred usefully, stored, or dissipated, but cannot be created or destroyed.

Technology

- Apply knowledge of materials and production processes to design products and produce practical solutions that are relevant and fit for purpose.
- Explore and experiment with ideas, materials, technologies and techniques.
- Generate, develop, model and communicate ideas in a range of ways, using appropriate strategies.

Introduction

This episode is designed to introduce the context. Not only does it emphasise the wild and potentially inhospitable nature of the environment that people need shelter from but it also alludes to the negative impact of people on the environment by drawing attention to glaciers.

Additional resources required

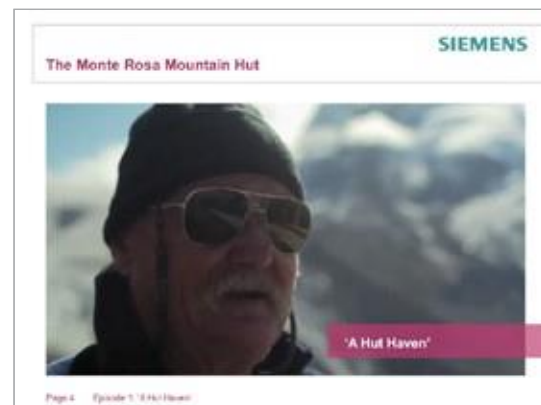
- Flip chart

Learning objectives

- To understand the nature of the mountain environment.
- To consider the challenge this represents for building design.

Learning activities

- 1. Show students the video “A Hut Haven” and ask for their reactions to the situation. Ask if anyone has been in similar environments.**
- 2. Ask students to work in groups and consider these questions:**
 - a) What needs to be considered when designing a structure like the Monte Rosa Mountain Hut?
 - b) How would the design of this have to be different from a building in a town?
 - c) Why would it need to be well designed in terms of energy?
 - d) How are environments like this being damaged through the way that energy is sometimes used?
- 3. Take feedback and gather points about the importance of energy efficiency, both in terms of keeping mountain walkers warm but also to reduce energy demands and avoid damaging the environment.**
- 4. Gather key points on a flipchart sheet or in some other way and display for future reference.**



Outcomes

- To have contributed to a set of ideas about the need for energy efficiency in a mountain hut.

The challenge

This episode is designed to focus students' ideas on the challenge of minimising energy losses from a building. It encourages analysis of how energy is lost, the relative proportions and strategies to reduce this.

Learning objectives

- Analyse the ways in which energy might escape from a house.
- Use the key terms conduction, convection and radiation.
- Propose ways to reduce energy loss.

Learning activities

- 1. Show students an illustration of a typical UK house and ask them how energy is lost from it. Encourage them to explain in detail how heat is transferred.**
- 2. Introduce (or revisit) the idea that heat can travel in three ways:**
 - a) Conduction – through solids by the particles vibrating and the energy being passed from one to another. This is how heat travels through a glass window, a uPVC window frame or a brick wall.
 - b) Convection – in a fluid where the material itself moves. Vibrating particles travel from one place to another. This is how air travels in air; as warmer air is less dense it rises.
 - c) Radiation – as waves radiating out from a warm object. This is how the 'direct' heat from a fire reaches you. (Note that heat from a fire also rises up by convection.)
- 3. Ask students to work in groups and decide which of these methods of heat transfer explains each of the routes by which energy is escaping from the home.**
- 4. Take feedback and draw out that:**
 - a) Heat escapes through the ceiling as hot air rises by convection and then travels through the ceiling by conduction. The same thing happens in the loft and through the roof.
 - b) Heat travels throughout each room by hot air rising by convection and by hot surfaces radiating outwards in all directions.
 - c) Heat travels through walls, windows, door and floor by conduction.
- 5. Then ask students to consider each of these 'escape routes' in turn and suggest how to minimise the heat loss, using the key terms.**



Outcomes

- To have suggested how energy escapes from a house with reference to conduction, convection and radiation.
- To have proposed ways of reducing this heat loss.

Investigate

This episode involves students in considering how they can further investigate the process of heat loss by the design, construction and use of physical models.

Learning objectives

- To explore the idea of using a model to investigate an object or process.
- To consider the advantages and disadvantages of using a model.

Learning activities

- 1. Explain that scientists sometimes investigate ideas by means of models. Say that a model is something that represents certain features of an object or process. It may or may not look like the object but it needs to behave like it in certain ways.**
- 2. Show pictures of various models and ask students to suggest why models are used. Draw out ideas such as:**
 - a) It makes it easy to discuss and think through what something looks like.
 - b) It gives us a way of representing very large and very small items.
 - c) It means we can think about changing something in a way that is easier than modifying the real thing.
- 3. Ask for suggestions as to why working with models might be misleading. Draw out ideas about the model that may be incorrect or not behave in the same way as the real thing.**



Outcomes

- To have developed and shared ideas about the uses and merits of models to explore an object or process.

Design

This episode involves designing a model building to investigate heat loss. This involves selecting a suitable material and developing a design to enable the construction of a simple house. Students will need to consider a material that is suitable to represent a real building and will need to reflect the properties of that material in the design. They may also consider whether a range of different designs might be a good way of testing the robustness of an explanation.

Additional resources required

Model making materials such as:

- Correx
- Cardboard
- Balsa Wood

Learning objectives

- To consider the properties of different materials and their suitability for the purpose of constructing a model.
- To explore whether the investigation will be improved by using a range of materials.

Learning activities

- 1. Explain that students will be designing a model house to test ideas about heat loss and insulation. Say that the building will be a simple one, but will nevertheless represent a real house, and will be used to test insulation.**
- 2. Present students with possible alternative materials. This might include:**
 - a) Correx.
 - b) Thick cardboard.
 - c) Balsa wood.
- 3. Ask students to consider the merits and disadvantages of each material. They might consider:**
 - a) Ease of working and joining pieces.
 - b) Extent to which it represents real building materials.
 - c) Cost.
- 4. Draw ideas together and decide on an approach. Ask students to explore the idea that having everyone use the same materials makes it easier to compare results and spot anomalies, whereas using different materials means that similarities in the findings would suggest that they apply to a range of materials.**



Outcomes

- To have presented advantages and disadvantages of several different materials.
- To have identified advantages and disadvantages with selecting one material or using a range on the quality of the results.

Develop

In this episode students develop a design for the house. This is a good opportunity to use design software as the design will be straightforward but may need modifications. Students will need to consider size, features and jointing techniques.

Additional resources required

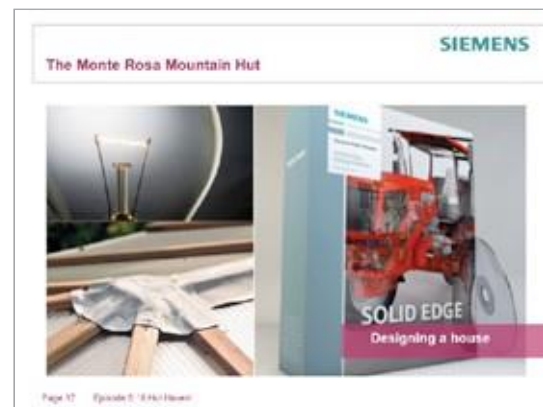
- Solid Edge® or simulator CAD software
- Sheeting for windows and other creative measures for insulation
- 12v filament bulbs

Learning objectives

- To consider various design factors to develop a plan for the house.
- To use the plan to produce parts for the model.
- To assemble the parts to construct the model.

Learning activities

1. Explain to students that the house will need to be a simple one-room design so that it can be constructed quickly and cheaply. Discourage elaborate designs or features that will be difficult to execute well. However the house will need certain features such as:
 - a) Loft, i.e. ceiling and roof.
 - b) Window.
 - c) Door.
 - d) Floor.
2. Explain to students as well that they will need to consider the size of the house. A good heat source is a 12V filament bulb so the house will need to be tall enough to accommodate this.
3. Explain that they will need to consider how joins are made in their selected material. Cardboard and Correx can be cut and folded; balsa wood will need a jointing strip. Ensure that students understand this.
4. Students can then use an application such as Solid Edge® to generate a design for the house. The outcome needs to be plans that can be used to cut parts to make up the house.
5. Once plans are agreed, they can be printed out and used as a pattern to cut the material. Guidance may be required at this point.
6. Pieces should then be joined to construct the house. The door should be hinged and windows added by using acetate sheet or similar.



Outcomes

- To have decided on the key aspects of the design, including size, features and jointing.
- To have produced plans that incorporate these features.
- To have constructed the model from the plans.

Investigate

In this episode students use the model houses to test the effect that insulation has on the ability of the bulb to keep the inside of the house warmer than the outside. Students select a particular aspect of the house to insulate and investigate the effect of altering the type or amount of insulation.

Additional resources required

- Thermometer
- Selection of insulation materials

Learning objectives

- To plan an investigation to test the effectiveness of various methods of insulation.
- To ensure that the investigation is a fair test.
- To conduct the investigation and construct a conclusion.

Learning activities

1. Explain to students that they are going to investigate one way in which a building can be insulated and find out how the amount or type of insulation can make a difference.
2. Provide a range of materials and introduce them briefly.
3. Explain that they will investigate the effectiveness by measuring the temperature inside the house over a period of time and compare it with the temperature on the outside. If it is loft insulation that is being tested, it should be possible to compare the temperature inside the house with that in the loft and that outside. Temperature may be recorded either using conventional thermometers being read regularly or using data logging equipment to record and display readings.
4. Ask students to work in groups to select the way that they will investigate insulation. They will either need to be investigating the type of material or the amount. Ask them to consider how they will make it a fair test, i.e. by only altering one factor between each test.
5. Ask for a plan of the steps in the investigation. Students should then run the test, initially with no insulation, and find out how the temperature changes due to the bulb as a heat source. After being allowed to cool down, insulation should then be introduced and the experiment repeated.
6. The results should be displayed, compared and used to construct a conclusion about the effectiveness of the insulation. This should indicate what impact the insulation has had and suggest why, drawing on the data.



Outcomes

- To have planned and carried out an investigation into an aspect of insulation.
- To have gathered and processed results to support a conclusion.

Conclusion

This episode requires students to consider how their understanding of insulation can now be applied to a design for a modern mountain hut.

Learning objectives

- To apply ideas about energy efficient building design to a different context.

Learning activities

- 1. Draw together key points from earlier episodes, including references to:**
 - a) How heat escapes from a building.
 - b) The outcomes from the investigations.
 - c) The context of a mountain hut.
- 2. Ask students to look at the pictures of the hut and to consider ways in which the design enables the building to be very energy efficient.**
- 3. Ask students to share their ideas and draw together key points, including the orientation, the size of the windows and the shape of the hut. Ask students to suggest how the hut might be insulated and develop ideas about wall, window and ceiling insulation.**



Outcomes

- To have suggested how the mountain hut design could be made energy efficient, using ideas developed during the topic.