THE ENERGY HOUSE

Goal(s):

The aim of the activity is for the pupils to learn about energy conservation and energy efficiency, including cost implications. The activity is based on the fact that the heating and cooling of a building uses more energy than anything else. The pupils learn the importance of finding ways of reducing the energy needed to keep their classrooms at comfortable temperatures. This activity focuses on insulation.

General description of the activity:

The activity is in two parts in groups of 3+ children.

- The pupils have the challenge of taking an imaginary building, a "box-house", to design it and decide how best to insulate it, using a wide variety of insulating materials provided by a "Building Centre". They take real temperature measurements and finally they compute the energy savings achieved, according to a formula presented by the teacher.
- After the calculations are completed, the second part of the activity proceeds with an extensive discussion between the teacher and the pupils about the energy savings that insulation can produce, as well as about other materials that the pupils could have used as insulators (there may have to a discussion at the beginning to establish that the pupils understand the concept of 'insulation' see steps below).

Required materials:

- 10* identical cardboard boxes (approximately 30cm × 30cm × 30cm)
- 10 pieces of heavy transparency film
- Roll of aluminium foil
- 1 package of small bead polystyrene
- 1 package of small self-stick weather strip (also called draft excluder strip)
- 1 roll of bubble wrap
- 1 roll of cotton wool
- 1 roll of padded mailing paper or several padded envelopes
- 10 rolls of masking tape or selotape
- 10 pairs of scissors

- 10 rulers
- 10 poster boards (thick cardboard)
- 10 plastic Zip-lock bags (15cm × 15cm)
- Ice cubes
- Several thermometers
- Thermometer holders (for the box centre)

* *10 is indicative; it depends on the number of groups formed (e.g. 10 stands for 10 groups of 3 pupils each).*

Required pupil skills:

Counting, measuring temperature, handicraft, mathematics (for simple calculations), knowing the concept of 'insulation'.

How does this activity fit into the curriculum:

This activity is well suited for lessons in Mathematics and Physics, as well as the Experimental & Investigative Science. Good opportunities for speaking and listening and cooperative group work.

Safety issues:

Slip jeopardy due to dripping ice cubes.

Individual steps of the activity:	Required time:
1. Discuss 'conductors and insulators'. Stimulate discussions between the pupils on what they know about common materials (wood, plastic, glass, metal, cement, etc) and categorize them as conductors or insulators. See Aid 4 to help this process	~ 30 minutes
2. Distribute to each one of them: ➢ A relevant Guide (the "Pupil Guide"), where the purpose as well as the steps of the procedure to be followed are described (see Aid 1); ➢ A "Building Code", rules by which they have to design and insulate their houses (see Aid 2), and ➢ The "Cost Sheet", where all the materials possibly used, their cost, and all calculations that will be made by the pupils will be written down (see Aid 3).	~15 minutes
3. Set up a "Building Centre". Also remind the pupils about safety rules.	~ 15 minutes
4. The pupils are placed into groups of three. Each group is given its "box-house". The groups need to cut windows and doors. They need to decide the type and amount of materials	~ 30 minutes

	they want and write them down on the "Cost Sheet". Then, one representative from each group visits the "Building Center" to get the materials (your role is to act as the Center Manager).	
5.	The pupils insulate their "houses", according to a specific "Building Code".	~ 1 hour
6.	When the pupils are finished, distribute to them plastic bags filled with ice cubes. ➢ Their houses are then closed up with the bags of ice left on the floor of each house. ➢ Temperature of the classroom is measured and recorded on their "Cost Sheets". ➢ After ten minutes, you must ask the pupils to measure the temperature of their houses by carefully sliding a thermometer above the door, and this is recorded on their "Cost Sheets" as well. During this step you should explain the formula for the calculation of energy savings (described in the Cost Sheet), and then ask each group to calculate their own house's savings, over a ten year (suggested time period) period.	~30 minutes
7.	Discussion the energy savings that insulation can produce, especially in the context of cost – the more insulation you use, the more energy savings. Also discuss other materials that the pupils could have used as insulators, such as foam board. Finally, ask about what they would change if they could repeat the activity with additional or alternative materials.	~ 30 minutes

Suggestions for combination with other AL activities:

"Special energy investigators" – The pupils experiment with three types of heat transfer, namely conduction, convection, and radiation.

[The listed activities above may change when all the activity sheets have been finalised.]

Variations:

- A simpler task for younger pupils would be to insulate cold drink cans with various materials to see which material keeps the liquid the coldest.
- The pupils could draw plans of their houses to scale and show where they would use insulation.
- Have a building contractor visit the class to discuss energy-saving materials and techniques in the building industry.
- The pupils could survey the school to determine how well the building is insulated and what measures could be undertaken to make their school more energy-efficient.
- The pupils could survey their own homes to determine how well their homes are

insulated and what measures could be undertaken to make their homes more energy-efficient.

Available aids:

Aid 1 – Pupil Guide – Energy House, describing the purposes and the step-by-step procedure of the activity

Aid 2 – Building Code – A set of rules that must be strictly followed by the pupils while designing and insulating their "Energy Houses".

Aid 3 – Building Centre – Cost Sheet

Aid 4 – Material for slides with "Insulators & Contactors" and "Answer key" presenting some typical insulators and contactors used in everyday life, which will be used for the introduction to the activity.

Pupil Guide – Energy House

Purposes:

- To explore energy conservation / efficiency measures.
- To insulate your house using materials from the Building Centre according to the "Building Code" and calculate the energy savings over a ten year period.

Procedure:

- Draw two windows (10 cm x 10 cm) and one door (10 cm x 20 cm) on your house.
- Carefully cut out the windows and the door, leaving one side of the door attached.
- Look at your house to find out its insulation needs. Read the "Building Code".
- Look at the materials available and their cost. As a group, decide which materials you want to use and their amount. Write them out on your "Cost sheet".
- Buy the materials and insulate your house, following the "Building Code". You can buy extra materials if you need them, adding them to your "Cost Sheet".
- When your house is finished, fill a plastic bag with eight cubes, place it flat on the floor of the house and close the house.
- Measure and record the temperature of the classroom.
- After ten minutes, record the temperature of your house at ceiling level by carefully sliding the thermometer into the house through the top of the door, taking care not to allow cool air to escape.
- Calculate your energy savings on your "Cost Sheet".
- Compare your energy savings with that of other groups. What would you do differently if you could do the activity again?

BUILDING CODE

- The door must open and close. If you add a storm door, it must open.
- Windows do not have to open, but you must be able to see through them.
- The ceiling must be at least 5 cm above the top of the door.
- Insulation on the floor and walls cannot be more than 1 cm thick.
- No insulation should be seen. All insulation must be covered by a ceiling, wall or floor (thick cardboard).

BUILDING CENTER – COST SHEET

AMOUNT				TOTAL COST
_____	Mailing Tape	*	€0.50 roll	_____
_____	Plastic Film	*	€0.25 each	_____
_____	Aluminum Foil	*	€0.20 / metre	_____
_____	Poster Board	*	€0.50 each	_____
_____	Bubble Wrap	*	€1.00 / metre	_____
_____	Cotton Batting	*	€0.75 / metre	_____
_____	Padded Paper	*	€0.50 / metre	_____
_____	Caulking	*	€0.01 / cm	_____
_____	Wheatherstripping	*	€0.01 / cm	_____

TOTAL COST FOR MATERIALS: _____

1. ROOM TEMPERATURE (°C): _____
2. HOUSE TEMPERATURE (°C): _____
3. DIFFERENCE (Δ) IN TEMPERATURE (°C): _____

Total Savings = [Δ (in °C) * (€3.00 / °C / year * 10 year)] – Cost of Materials

4. TOTAL SAVINGS: _____
5. IF I DID THE ACTIVITY AGAIN, I WOULD CHANGE:

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Insulators and conductors

Answer Key

- **Metal Pan with Plastic Handle and Knob:** Metal is a conductor – it conducts heat to the food inside to cook it efficiently. Plastic is an insulator – it does not conduct heat from the pan to a person's hands.
- **Metal Kettle with Wooden Handle and Knob:** Metal is a conductor – it conducts heat to the water inside to warm it efficiently. Wood is an insulator – it does not conduct heat from the kettle to a person's hands.
- **Metal Spoon with Plastic Handle:** Metal is a conductor – it conducts heat. Plastic is an insulator – it does not conduct heat from the spoon to a person's hands.
- **Fabric Oven Mitts:** Fabric is an insulator – it does not conduct heat from hot pans to a person's hands. Discuss blankets and clothes as insulators. What would happen if the fabric mitts got wet? Is water a conductor or insulator?
- **Thermos (Vacuum) Bottle:** There is a space between the inside liner and the outside material of a vacuum bottle in which most of the air has been removed. Since heat travels from molecule to molecule, a space with few molecules is a good insulator. Double pane windows work on the same principle.
- **Ceramic or Plastic Cup:** Ask the pupils whether the cup would be hotter if made of ceramic or plastic. Which is the better insulator?

Search words:

General Topic	Energy topic	Educational subject	Age level
Transport	General sustainable development	**Science**	6-8 years
Space heating & cooling	Renewable energy	**Mathematics**	**9-10 years**
Hot & cold water	**Energy efficiency (saving)**	**Physics**	**11-12 years**
Lighting	CO_2 wise transport	**Arts & crafts**	
Electric appliances		**Literacy**	