SPECIAL ENERGY INVESTIGATORS

Goal(s):

- To increase children's awareness of the 'thermal climate' in their classroom and what influences it (everyone feels and works better when they are comfortably warm or cool).
- To understand the 3 types of heat transfer: **Conduction**, **Convection** and **Radiation**.
- To enable the pupils to describe ways to avoid unnecessary heating and cooling.

General description of the activity:

The pupils in a classroom are divided to 3 groups, each of which will have to carry out one **"heating and/or cooling related experiment"**.

- Group 1 will carry out the "Hot and Cold Spots in the Classroom" experiment,
- Group 2 will carry out the "Draft-o-Meter" experiment
- Group 3 will carry out the "Hot Cans & Cold Cans" experiment

After completing the experiments, the 3 groups will explain to the other ones what they have tested and learned. This will lead into a discussion about how and why we waste energy when heating or cooling a classroom. In other words the pupils need to:

☺ detect cases of energy waste;
☺ identify what may cause any energy waste;
☺ take steps to prevent energy waste;
☺ report on the success of their activities.

Required materials:

- Squared or graph paper
- Room thermometers
- Laboratory liquid thermometers
- Timer
- Pencil
- Tape
- Plastic food wrap
- Identical soda cans
- Scissors for all children
- String
- Glue

- Staples
- Any sort of useful junk or anything else that could be used as insulating or conducting material, or material that will absorb or reflect radiation (for more detail see Aid 4 below).

Required pupil skills:

Counting, taking and reading temperature measurements, basic drawing skills, and simple representation of measurements on a graph, ability to work in a group.

How does this activity fit into the curriculum:

Experimental and Investigating Science, Arts and Painting (children' ability to creatively represent their environment), Using and Applying Mathematics, Basic Physics (the three types of heat transfer), Literacy.

Safety issues:

The pupils should be shown the safe use of scissors, pencils and rulers). The hazards of swallowing glue, foam and other activity should also be highlighted.

Individual steps of the activity:	Required time:
1. Introduce the concept of "heat" as a form of energy and the ways heat transfers from warmer to colder materials. It is important to highlight the difference between the concept of "heat" from that of "temperature". There could also be a discussion about the role of heat in our everyday lives and how we are constantly trying to control it for comfort (either by cooling or heating the air around us).	~ 30 minutes
2. Divide the class into three groups (one for each of the three investigation cases): ➢ Group A – "Hot and Cold Spots in the Classroom", ➢ Group B – "The Draft-o-Meter", ➢ Group C – "The Hot Cans and Cold Cans". 3. Use different coloured labels to distinguishing the groups. 4. Hand out the Aids and necessary materials to each group: ➢ Aid 1 to the pupils of Group A (Guidelines: *"Hot and Cold Spots in the Classroom"*). ➢ Aid 2 to the pupils of Group B (Guidelines: *"The Draft–o-Meter"*), together with the "Classroom Draft Checklist" (Aid 3), which pupils will use at the end of the Experiment of Group B. ➢ Aid 4 to the pupils of Group C and table with "Heat Transfer coefficients of typical insulation materials" (Aid 5), also *"The Hot Cans and Cold Cans"* (Aid 6).	~ 1 hour

Go through the necessary clarifications and explanations, after the pupils have been given all the Aids and materials.	
5. All groups to undertake experiments. You will need to circulate and help them. In particular they will need guidance on the timings of each part of the activity. *<u>Note:</u> The experiment of Group A is best to done in the morning, before the school warms up, to detect greater temperature differences.*	~ 1,5 hour
6. Hold a case conference: Call a meeting of all the 3 "Special Energy Investigators Groups" assigned to carry out the above Cases. Have each group explain to the other two groups what they did and how they worked. Encourage them to compare their observations: ➢ When and where was heat being wasted? ➢ What is common about the times and places? ➢ Who are the witnesses and the suspects? ➢ Where were most of drafts detected? ➢ How successful were the heating and cooling device? 7. As a plenary ask individuals for a definition of conduction, convection and radiation and write them up on board to reinforce the concepts once again!	~ 2 hours
7. A longer term project could take all the above further i.e.: ➢ What can be done to make sure that energy is properly used? ➢ How can children, teachers and other adults help prevent the waste? ➢ Prepare and present a report to your Senior Officers (teachers and head-teacher) ➢ Explain the advantages of your scheme and how it can be carried out.	~ 4 hours

Suggestions for combination with other AL activities:

"The energy house" – The pupils test the importance of the building envelope relative to energy consumption.

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

Variations:

Wider dissemination and active use: The activity can be used as leverage for a school wide discussion on indoor climate improvements.

- When your Senior Officers have had time to consider your plan, ask them which parts they intend to put into operation.
- Invite the three groups to visit another (same grade) classroom and make a presentation of the experiment each of them has carried out. In addition, let the

pupils offer the other classroom's pupils their assistance in order for them to be involved with a similar activity themselves.

- Make careful notes of what you find out.
- Call another case conference and discuss progress. Update your report.
- Decide what should be done next.

Available aids:

Aid 1 – Guidelines for Group A - "Hot and cold spots in the classroom"

Aid 2 – Guidelines for Group B - "Draft-o-meter"

Aid 3 – Classroom draft checklist

Aid 4 – Stand full of useful junk

Aid 5 – Heat transfer coefficients of typical insulation materials

Aid 6 – Guidelines for Group C - "Hot cans and cold cans"

Guidelines for Group A

Procedure for the "Hot and cold spots in the classroom"

- Take a piece of graph or squared paper.
- Draw a plan of your classroom, from a birds eye view.
- Decide which areas of the classroom would be the hottest and the coldest. Mark these areas on your drawn plan with an H or a C, so that:
  - H depicts a hot spot,
  - C depicts a cold spot.
- Use room thermometers to measure the air temperature in the following areas of the classroom:
  - near the windows
  - near the space heating device
  - near the air conditioning device
  - on the floor
  - inside a cupboard
  - by the door.
- Record the temperatures of the hot and cold spots by taking temperature readings at regular intervals of (e.g. 5-10) minutes. Notice how the temperatures change.
- After taking the temperature readings, decide whether your original guesses about the hot and cold spots had been correct or not…
- Discuss with your teacher how you can make best use of the hot spots to warm up the cold spots and vice versa.
- Draw a new layout of the classroom that makes best use of the hot and cold spots.

Guidelines for Group B

Procedure for the "Draft-o-meter"

- How draughty are your rooms?. Drafts are signs that air is leaking into or out of the classroom. This means either a loss of heat in winter or a loss of air conditioning in summer. Your mission is to design and make your own draught detector (being called "Draft-o-Meter"), which will help you to collect evidence of potential problems.
- Cut a 12cm by 25cm strip of plastic wrap.
- Tape the shorter edge of the wrap to a pencil and let the rest hang freely.
- Then blow the plastic wrap gently and note how sensitive the wrap is to air movement.
- When you are finished with the above steps, complete the "Classroom Draft Checklist" (see Aid 3), to assess where drafts are in your classroom.

Classroom draft checklist

Using your draft-o-meter investigate the draft in various locations within your class room where drafts are likely to appear. Rate the draft measure – strong, moderate, weak, no draft – and enter your results in the table below.

Location	Rating			
	Strong	Moderate	Weak	No
Door				
Windows				
Exhaust fans in the classroom				
Light fixtures attached to walls and ceilings				
Window air-conditioning unit left in place in winter				
Mail chutes or slots in walls or doors				
Cracks in the foundation or holes where pipes pass through				

Stand full of useful junk

The stand should include anything that could be used as insulating or conducting material; or material that will absorb or reflect radiation, such as scraps of fabric (various sizes), socks from the lost & found, packing peanuts of several types, pieces of foam (various sizes), construction paper (both light and dark colours), bubble wrap, newspapers, quilt batting, old overhead transparencies, rubber tubing, drinking straws, funnels, aluminium foil, large zipper-type plastic bags, etc.

Heat transfer coefficients (at an ambient temperature of 25°C)

Heat transfer coefficients are used to express how good materials are at transferring heat. The heat transfer coefficient is called "thermal conductivity" – k – and is measured in W/m*K. The smaller the number, the better the material is at retaining heat.

Find this hard? Get your local Energy Agency to help!!

Material/Substance	k
Acrylic	0.20
Asbestos, loosely packed	0.15
Asphalt	0.75
Corkboard	0.043
Cotton	0.03
Cotton Wool insulation	0.029
Felt insulation	0.04
Fiberglass	0.04
Fiber insulating board	0.048
Foam Glass	0.045
Glass	1.05
Gypsum or plaster board	0.17
Hardboard high density	0.15
Leather	0.14
Nylon 6	0.25
Paper	0.05
Plaster, gypsum	0.48
Plywood	0.13
Polyethylene HD	0.42–0.51
Polypropylene	0.10–0.22
Polystyrene expanded	0.03
PVC	0.19
Rock Wool insulation	0.045
Sand, dry	0.35
Sawdust	0.06
Straw insulation	0.09
Styrofoam	0.033
Water	0.58
Wool felt	0.04

1 W/(m*K) = 1 W/(m*C) = 0.85984 kcal/(hm*C)

Guidelines for Group C

Procedure for "Hot cans and cold cans"

- You will investigate heating and cooling in a controlled situation. This require from you to keep one mass of water warm and one mass of water cool, using only common everyday materials. You will have to get the water in one of your cans as cool as possible in 30 minutes, while keeping the other as warm as possible for the same amount of time (see description below).
- Your group will be given two soda cans, both filled with water at about 35°C.
- Visit the "Stand of useful junk" and examine the materials.
- Choose from the materials available on the "stand of useful junk" to make your cooling and warming devices.
- Use the table indicating the heat transfer coefficients of basic insulation materials (see Aid 5).
- According to the values of the table and the available in the stand materials, you need to choose the best material for keeping heat in or transferring it.
- You have 20 minutes to make your devices.
- Record the temperatures inside both cans every 5 minutes.
- Your teacher has filled two additional cans with the 35°C water and left them sitting in a central location. These will serve as "control cans". So, one of you (as assigned by your teacher) will need to also check the temperatures in these cans at the same 5-minute intervals.
- Compare the results of the group's cans to the temperatures of the "control cans".
- Prepare a representation of the changes in temperature over time for your two cans, along with the one of the control cans, on the same graph.

Search words

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