D1: RETAINING HEAT ENERGY

Overview

Much of our heat energy is produced using costly and dwindling secondary sources of energy. Because it is believed to account for approximately 36% of domestic energy consumption, home heating is an important target in the European drive towards improved energy efficiency. Several legislative measures have been put in place to encourage energy efficiency when heating living spaces. In Ireland, for example, all residential buildings that are rented or sold must have a certificate called a Building Energy Rating (BER) that measures the energy consumption of the building.

This section looks at ways to reduce and prevent energy wastage in the home. The first lesson, **D1 ACTIVITY 1: COMPARING COFFEE CUPS**, is an introduction to insulation. Students test the insulation properties of disposable cups and then relate their findings to insulation in buildings. **D1 ACTIVITY 2: ICE MELTING** is a visual presentation of the insulating properties of a selection of materials such as wood, plastic, aluminium, and polystyrene.

D1 ACTIVITY 3: U-VALUES assesses how effective double-glazing is in preventing heat leakage through windows.

The next lesson, **D1 ACTIVITY 4: HEATING THE HOME**, shows how heat energy is transferred and transmitted around the house and illustrates the importance of insulating heating components.

Finally **D1 ACTIVITY 5: THE GOOD HOME**, is a project aimed at giving students a deeper understanding of BERs, and an opportunity to examine different types of building materials.

The activity introduces and examines terms such as **passive home** and **geothermal heating**.

Suggested approaches:

- Distribute **D1 WORKSHEET A: ENERGY USAGE BY SECTOR**. Ask the students to link the **consumer** (column A) to what they guess is their corresponding percentage of **energy usage** (column B). When this is completed, show them the pie chart printout and facilitate a short discussion comparing the students' results with the pie chart.
- Ask the students to list the various purposes that energy is used for in the average household, i.e. heating, lighting, water heating, cooking, using various appliances. Finally ask them to estimate how much of that energy list relates to 'heating for comfort living' (about 36%).
- Ask the students to list all the ways in which energy can be wasted at home or in school (i.e. doors left open). Then ask them to list ways that energy can be saved.

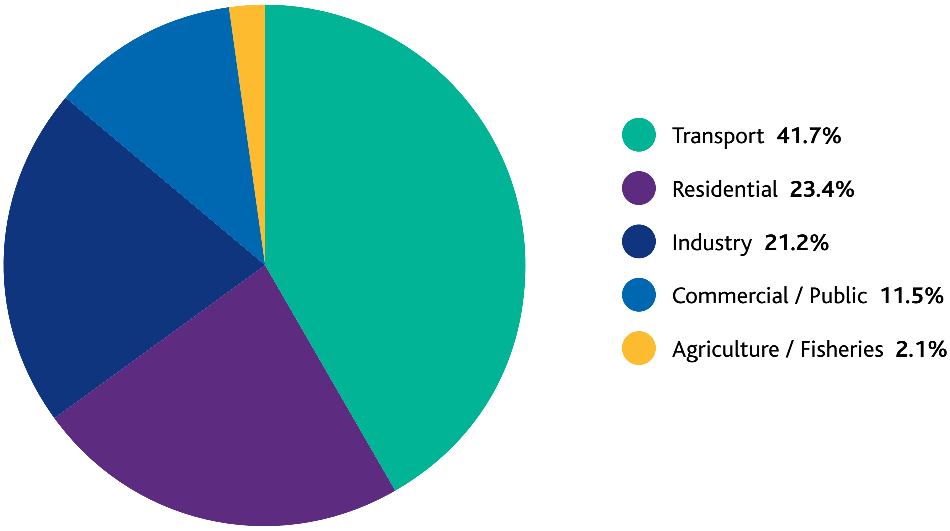
NOTE:

D1 WORKSHEET A: ENERGY USAGE BY SECTOR

A: CONSUMERS	B: % ENERGY USAGE
Commercial / Public	41.7%
Transport	11.5%
Industry	2.1%
Residential	21.2%
Agriculture / Fisheries	23.4%

Source: SEAI Energy in Ireland 2015 Report

D1 Printout: Pie chart



NOTE:

These figures are for 2014 energy usage in Ireland. For annual updates please see the latest SEAI Energy in Ireland report which can be downloaded from the SEAI website.

D1 ACTIVITY 1: COMPARING COFFEE CUPS

Background

In this activity students use a disposable cup to test the insulation properties of various materials. There are two aspects to this investigation – one aspect looks at the merits of using a sleeve for holding the cup and the second one considers the materials of various coffee cups. The activity is an opportunity to teach students about the importance of applying the 'fair test' principle and considering all variables when making an assessment.

Suggested approaches:

- For this exercise the class is divided into group A and group B.
- Both groups are presented with the materials and given a brief of what to do. After a set period of time, each group presents the best insulation material according to their findings, and explains why this material provides better insulation than the others.
- Alternatively, each group can source their own material from a collection presented to them, and test their insulating properties. After a set period of time, each group presents an appropriate argument supported by their findings as to why their cup or sleeve is best.
- Another approach would be to divide the class in three. Group C could act as an audience. They could put their own questions to the groups as well as listening to the presentations.

Equipment required:

GROUP A:

- Five strong paper or polystyrene cups
- Five lids to fit the cups. If the lids do not have a gap for drinking through, pierce a hole in each lid, big enough for the thermometer to be inserted.
- Bubble wrap of sufficient size to cover one cup
- Cotton wool sheet of sufficient size to cover one cup
- Aluminium foil of sufficient size to cover one cup
- Foam sheeting of sufficient size to cover one cup
- Four elastic bands
- Five beakers or measuring jugs
- Timer
- Five thermometers
- Kettle or other water heating facility
- 1.5 litres water
- Paper and pen for taking notes
- Pencil and ruler for drawing graphs
- (Optional) Add any other material that the students wish to test for insulation properties. Add an extra cup, beaker, elastic band, lid, and thermometer per extra insulation material.

GROUP B:

- One Styrofoam cup
- One disposable plastic cup
- One smooth paper cup
- One disposable cup of fluted paper
- Four lids to fit the cups. If the lids do not have a gap for drinking through, pierce a hole in each lid, big enough for the thermometer to be inserted.
- Kettle or other water heating facility
- 1.5 litres water
- Timer
- Four thermometers
- Four beakers or measuring jugs
- (Optional) Any other type of disposable cup that may be tested for insulation. Add a lid, beaker and thermometer per extra cup.

What to do:

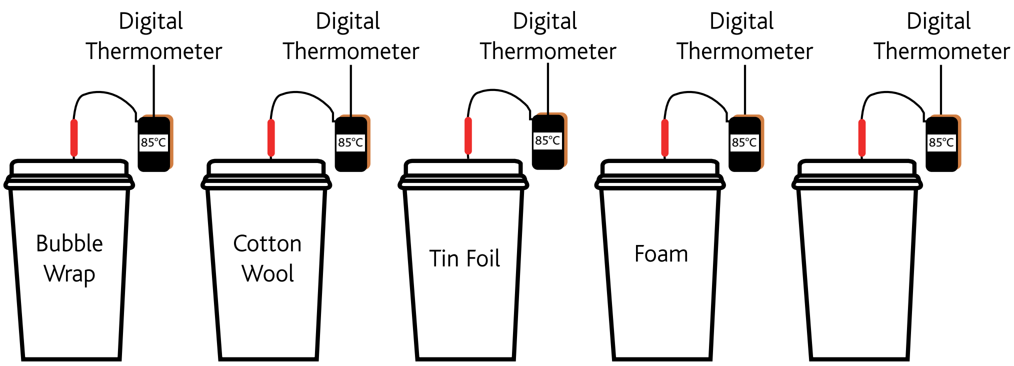


Figure 1

GROUP A:

1. Cover each cup with one of the insulation materials and hold in place with elastic bands. Leave the fifth cup bare.
2. Heat the water to approx. 85°C.
3. Measure 200 ml of water into each beaker and pour rapidly and simultaneously into the five cups.
4. Replace the lids.
5. Insert a thermometer through the slot in each lid.
6. Read and record the temperature of water in each cup.
7. Using the timer record the temperature every five minutes over a period of 40 minutes.

   ? ***What do you notice?***

   ? ***Why do you think this is happening?***
8. Discuss what type of graph would be appropriate for showing your results. Choose one, and draw it up.

GROUP B

1. Heat the water to approx. 85°C.
2. Measure 200 ml of water into each beaker and pour rapidly and simultaneously into each of the cups.
3. Replace the lids.
4. Insert a thermometer through the slot in each lid.

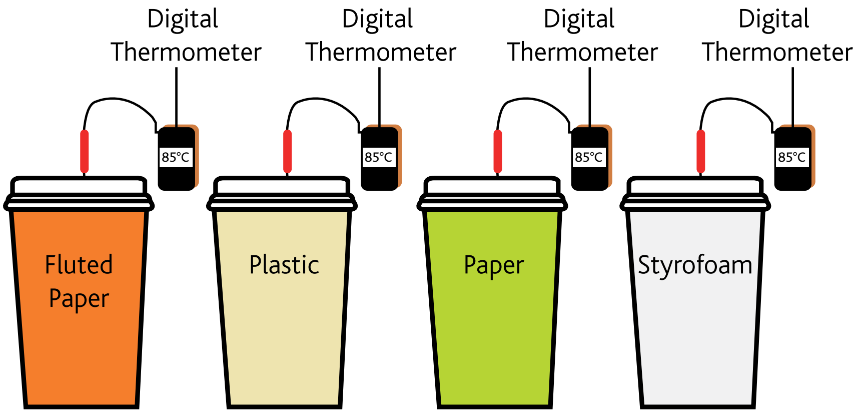


Figure 2

5. Read and record the temperature of the water in each cup.
6. Using the timer record the temperature every five minutes for a period of 40 minutes.
   - ***What do you notice?***
   - ***Why do you think this happened?***
7. Discuss what type of graph would be appropriate for showing your results. Choose one, and draw it up.

Resources:

- The SEAI website has a useful PDF on home insulation.

D1.1 DISCUSSION POINTS: INSULATION MATERIALS

1. In **D1 ACTIVITY 1: COMPARING COFFEE CUPS**, did using a sleeve help to retain the heat in the drink?
2. Houses lose their heat mainly through the walls and the roof. There are many ways heat loss can be reduced by treating the outside walls, from using pebble dash to stone cladding. Using the online resources in this section, investigate what is available and how effective each option is.

D1 ACTIVITY 2: MELTING ICE

Background

This activity is designed to teach students to identify the variables that influence heat conduction. By allowing students to see with their own eyes the influence of different materials on the transfer of thermal energy between bodies at different temperatures, the lesson gives them a chance to develop a deeper understanding of the nature of insulation and the rationale behind classifying materials according to their ability to conduct heat.

Suggested approaches:

- Before laying out the ice cubes, ask the students to touch the plates and discuss the sensations of warmth and cold that arise from touching different materials. This is a good stage to talk about body temperature.
- At the beginning of class, distribute **D1.2 WORKSHEET B: ICE MELTING**. Students can fill in the first two questions immediately, and complete the rest of the sheet as the ice cubes melt.
- As the ice cubes are been placed on the plates, ask students to **predict** which will melt first. The predicted order of melting can then be compared with the observed results.

Equipment required:

- Seven different plates:
  - ✔ ***Three aluminium, each of a different thickness and area***
  - ✔ ***One wood***
  - ✔ ***One Plexiglas***
  - ✔ ***One Styrofoam***
  - ✔ ***One marble***

  (substitute for other construction materials where these are not available)
- One surface temperature sensor
- Seven ice cubes of identical size and shape
- **D1.2 WORKSHEET B: INSULATION MATERIALS**, one per student (Alternatively, they can just make notes in their copybooks.)

What to do:

1. Lay each of the plates out on a table. Use pieces of folded paper to label the plates A, B, C, D, E, F and G as shown in Figure 3.

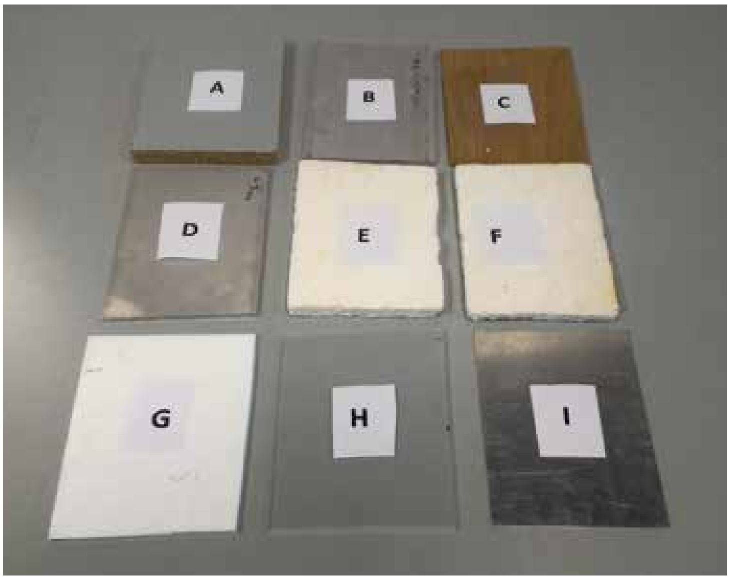


Figure 3

2. Write a list of the plates on the blackboard or whiteboard. **DISTRIBUTE D1.2 WORKSHEET B: INSULATION MATERIALS** and ask the students to follow the instructions. Alternatively ask them to make a list in their copybooks.
3. Take the initial temperature of each of the plates and record it on the board.
4. Place an ice cube on each plate and start the timer.
   - ***Discuss the concepts of thermal equilibrium and heat transfer with the class.***
   - ***Take predictions about which ice cube will melt first.***
5. Once the cube **starts** to melt stop the timer. Take the temperature of the plate and make a note of it.
6. When every ice cube has completely melted, **discuss the results** with the class and compare them with the predictions. Ask them to make hypotheses about the influence of **different materials** and **different** variables on melting times.
7. Elaborate on the concept of thermal conduction by discussing with the students how to analyse the different variables influencing the results.

D1.2 WORKSHEET B: INSULATION MATERIALS

1. Whenever we touch objects we receive feelings of warmth or cold. This depends partially on what the objects are made from. Consider the different feelings we have when walking barefoot upon a woollen carpet or upon a marble floor. In the same way, when we touch a metal object we have a feeling of cold quite different from the feeling of touching a piece of wood.

   A) CAN YOU EXPLAIN WHY THIS HAPPENS?

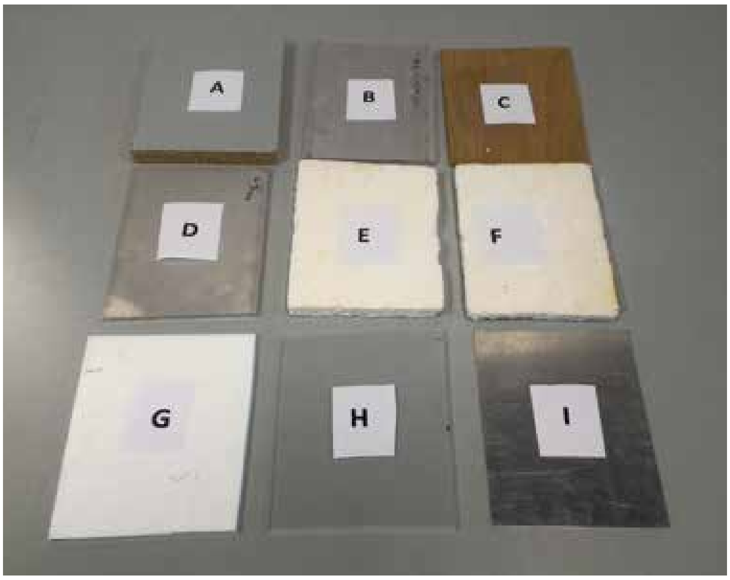
   B) DESCRIBE AN EXPERIMENT THAT WOULD DEMONSTRATE YOUR ANSWER.

2. If we want to prevent ice cream or deep-frozen food from melting during the time taken to cover the distance between the shop and home, we have to use special containers that provide thermal insulation.

   A) WHICH MATERIAL MAKES THE CONTAINER A GOOD INSULATOR?

   B) IS IT BETTER TO USE METAL, GLASS, OR PLASTIC?

Use this simple experiment to provide an answer to these questions.



On the desk we see seven different plates. Each plate is identified by a letter (from A to G). The first three plates (A, B and C) are of aluminium and differ in area and thickness. D is a wooden plate, E is Plexiglas, F is marble, and G is Styrofoam.

Touch the plates and describe the thermal feelings you receive.

Now your teacher will place an identical ice cube on each plate. Before observing what happens, try to **predict** the melting order of ice cubes, starting with the quickest one.

In the following table, make a note of the order in which the ice cubes melt. The first plate with a melted cube will be labelled '1', and the last one will be labelled '7'.

A	B	C	D	E	F	G

Describe what you have observed and make a comparison with your predictions.

D1.2 DISCUSSION POINTS: ICE CUBES

1. Why do the ice cubes melt when they are placed on the plates?

2. Which properties of the plates do you think may affect the melting rates of the ice cubes?

3. Do you think that the melting rates may depend on the initial temperature of the plates?

4. Which plate is, in your opinion, the best insulator and which is the best conductor?

5. Is the heat absorbed by each ice cube the same for all the cubes?

D1 ACTIVITY 3: U-VALUES

Background

U-values are **numerical** values which indicate the **thermal insulating properties** of materials. **A low value** indicates that **little heat loss** takes place, whereas a house with poor thermal insulation would register a high U-value. Calculating a U-value involves many **variables**, such as the orientation of a house, the area in question and the nature of the building material. This activity focuses on one particular variable; the temperature difference between the outside and the inside of a building. Using CD boxes as models for single and double-glazed windows, the hands-on activity allows students to investigate for themselves whether double glazing is better than single glazing at preventing heat loss.

Suggested approaches:

- Start a discussion by asking the students what they think the difference is between double-glazed windows, triple-glazed windows and single-glazed windows.
  - ? ***Which one would be good to install and why?***
  - ? ***What advantages or disadvantages does one have compared with another?***
- Ask them if they have ever heard of **U-values**.
  If so, can they explain them?
  - ? ***What values do they represent?***
  - ? ***What do these values relate to?***
  - ? ***Who might use them?***
  - ? ***When might they be important?***

Equipment required (per group):

- Two clear CD boxes
- Sellotape to seal the CD box
- A CD marker or labels and biro
- Two small labels
- Thermometer or temperature sensor
- An adjustable lamp with a 40/60 W bulb
- A stopwatch and ruler
- **D1.3 WORKSHEET B: RECORD SHEET FOR U-VALUES**

What to do:

1. Use the Sellotape to seal one of the CD boxes so that there are no air gaps, paying particular attention around the hinge. This CD box now represents a double-glazed window.
2. Label one side of the double-glazed window outside, and the other side inside.
3. Let both the thermometer and the window attain room temperature and then record that temperature.
4. Using the ruler, position the double-glazed window about five centimetres from the light bulb, which represents the heating system of a house. Make sure that the window side marked inside is facing it. Switch on the light and let it shine on the double-glazed window for two minutes using the stopwatch.
5. After two minutes, switch off the light.
6. Place the thermometer or sensor on the centre of the inside of the double-glazed window and record the highest temperature reached.
7. Allow both the thermometer and CD case to cool down to room temperature.
8. Repeat step 4.
9. Switch off the light but this time place the thermometer on the centre of the outside of the CD case and record the highest temperature reached.

10. Repeat steps 4 to 9 at least five times, filling in the record sheet for U-values.
11. Calculate the average inside temperature and the average outside temperature as indicated on the record sheet. Is there a difference between the two averages?
12. Now take the second CD case and separate the two parts at the hinge. One side represents a single-glazed window.
13. Label one side inside and the other side outside.
14. Using this 'single-glazed window' repeat steps 4 to 10 at least five times, filling in the record sheet in the appropriate section.
15. Calculate the average inside temperature and the average outside temperature as indicated on the sheet.

D1.3 DISCUSSION POINTS: GLAZING

1. Compare the average change in temperature for the inside of the double-glazed pane with the average change in temperature for the outside of the double-glazed pane.
   - ? ***How do they compare?***
   - ? ***Which window do you think has the better U-value?***
   - ? ***In winter you want to keep the inside warm – which window would you install?***
2. Use this activity to investigate if the type of curtains or blinds used can affect the amount of heat that passes through a window.
3. With the aid of a protractor, investigate if the angle at which the sun hits the window affects the temperature difference between the inside and the outside of a house.

D1.3 WORKSHEET B: RECORD SHEET FOR U-VALUES

A: **Double-glazed**

Room temperature **(A)**:

	INSIDE TEMP. (B)	TEMP. (B) – TEMP. (A)	OUTSIDE TEMP. (C)	TEMP. (C) – TEMP. (A)
1				
2				
3				
4				
5				

Average change in **inside** temperature:_________________

Average change in **outside** temperature:________________

B: **Single-glazed**

Room temperature **(A)**:

	INSIDE TEMP. (D)	TEMP. (D) – TEMP. (A)	OUTSIDE TEMP. (E)	TEMP. (E) – TEMP. (A)
1				
2				
3				
4				
5				

Average change in **inside** temperature:_________________

Average change in **outside** temperature:________________

D1 ACTIVITY 4: HEATING THE HOME

Background

This activity demonstrates a number of important principles for students. It can be used to encourage an understanding of how heat is transferred around the house and how a home heating system works, and should help students to understand the concept of a closed heating system and the problems caused by airlocks in 'radiators' (tubing acting as a radiator), as well as the role of insulation in reducing heat energy loss.

In the activity the boiling tubes and plastic tubing represent a 'closed' system and the hot water represents the source of heat (i.e. the Sun, or a boiler). The students can see that there is no physical contact between the heat source (i.e. the water in the large beaker) and the water in the boiling tubes yet heat energy is transferred. The migration of the food colouring will demonstrate the heat transfer.

Suggested approaches:

- Start with a short brainstorming session to see what the students understand by convection heating.
- Ask them to clarify for you their understanding of the direction of heat flow.

  ? ***Does heat flow from hot regions to cold regions?***

  ? ***Does it flow from cold regions to hot regions?***

  ? ***Do hot and cold flow towards each other?***

  As you carry out the activity, ask the students to describe what they see.
- If it is appropriate, challenge the students to carry out the role-plays demonstrated in Figure 4 and Figure 5. You will need between five and ten red balls to carry them out.

Conduction role-play:

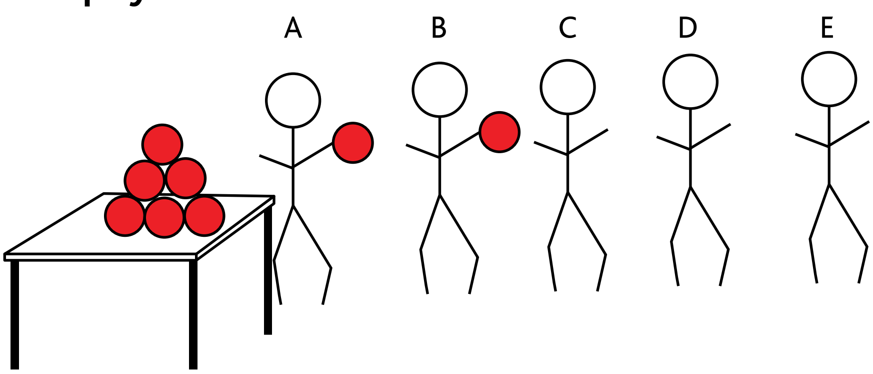


Figure 4

Role-play to demonstrate heating by conduction. Heat energy travels through the molecules but the molecules themselves do not move.

1. Place the red balls in a pile on the table or floor. The red balls represent the heat source.
2. Choose five volunteers. Name them A, B, C, D and E. They represent molecules of metal.
3. Stand them in a row in their letter sequence, with student A nearest to the heat source (red balls).
4. Explain to the students that they are going to demonstrate the heating process.
5. Ask student A to begin the heating process by picking up a red ball. This is to show the molecule acquiring heat energy.
6. Ask student A to pass the ball to student B who should pass it on to student C, who must pass it on. Explain that the molecules are conducting heat.
7. As soon as student A has passed on one ball, he or she must pick up another and pass it on until all the metal molecules have a ball. They are now the same temperature.
8. Explain that this movement of heat energy through the metal is referred to as **energy transfer by conduction.**

Convection role-play:

1. Now collect the balls into a pile again.
2. Select five new students and label them A, B, C, D and E. These students represent the molecules of a liquid or a gas.
3. Organise the molecules in a row.
4. Student A is nearest to the heat source (red balls) and so once the heating process starts will acquire a quantity of heat energy.
5. Explain that these are not metal molecules, so they will not behave like the previous group.
6. Ask student A to take a ball and move to the end of the line with the energy quantity.
7. Ask student B to move into the space, attain a quantity of heat energy, and move to the end of the line, while C moves nearer the pile of balls.
8. Explain that this movement of heated molecules is referred to as **energy transfer by convection.**

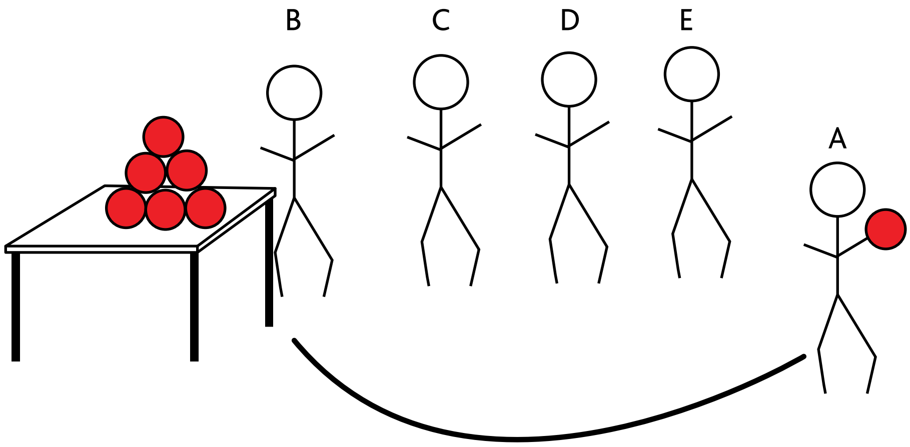


Figure 5
Role-play to demonstrate heating by convection. The molecule is heated and then moves, allowing the next molecule to be heated.

Equipment required:

- Two boiling tubes
- Two-holed bungs to fit tubes
- A boiling tube rack
- Plastic tubing to fit into the bungs
- Food dye
- Thermofilm strip
- 100/250 cm^3 beaker
- Hot water and cold water

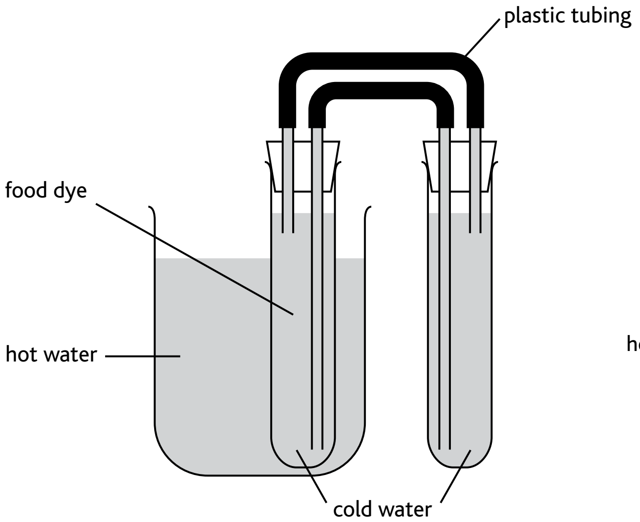


Figure 6

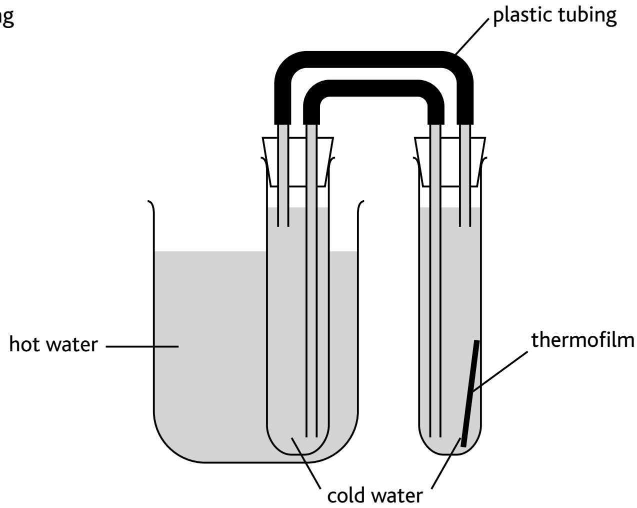


Figure 7

What to do:

1. Thread the plastic tubing through the two bungs as shown in Figure 6 and Figure 7.
2. Place the food colouring in one of the tubes, as shown in Figure 6.
3. Place the thermofilm in the other tube, as shown in Figure 7.
4. Almost fill both boiling tubes with cold water and push the bungs onto the boiling tubes, making sure that all tubing is below the water line.
5. Hold one of the boiling tubes upside down to eliminate any air pockets in the system.
6. Make sure that all the plastic tubing in both boiling tubes is under water.
7. Stand the boiling tube containing thermofilm in the boiling tube rack and the other boiling tube, containing food colouring, in a beaker of very hot water as shown in Figure 6 and Figure 7.
8. Record what you observe taking place

   ? ***What is happening in the boiling tube that is in the hot water?***

   ? ***What is happening in the boiling tube in the boiling tube rack?***

   ? ***What is happening in the plastic tubing connecting both boiling tubes?***

   ? ***What happens to the food dye?***

   ? ***What happens to the thermofilm?***

   ? ***What conclusions can you draw from your observations?***

D1.4 DISCUSSION POINTS: HEAT TRANSFER

1. In this activity, it is recommended that the boiling tubes are almost filled. What might happen if they are both filled to the top?
2. Why was it important to eliminate any air pockets?
3. What would happen if the hot water in the beaker was replaced with cold water?

   ? ***Why?***

D1 ACTIVITY 5: THE GOOD HOME

Background

In this topic students explore energy efficiency in the home. The activity aims at helping students to deepen their understanding of BER ratings and insulation materials, and to give them an insight into how these materials can be used to insulate their own homes.

Terms such as **passive home** and **geothermal heating** are introduced and examined.

What to do:

- Arrange the students into groups and assign different topics for them to research and present to the class in poster form. There are suitable research resources below.

  SOME EXAMPLES OF APPROPRIATE TOPICS ARE:

  - ***Insulating the attic (floor or eaves?)***
  - ***The pros and cons of different exterior building surfaces such as pebble dash or cladding***
  - ***Triple glazing versus double glazing***
  - ***Metal versus wooden window frames***

Resources:

- The SEAI website has a useful page on BER ratings.
- Learn the relevant terminology in buildings.
- Information on different types of external building materials.
- Get more information on Passive House from the Passive House Association of Ireland.
- It might be useful to show the class this short animated slideshow on passive housing.
- SEAI guide to home insulation.
- SEAI energy saving tips.

D2: THE ENVIRONMENTAL IMPACT OF USING ENERGY

Overview

Having researched various energy sources in **STRAND A: ENERGY AND SUSTAINABILITY**, students can now be encouraged to look at the impact that building such resources has on the environment. Students are asked to carry out an environmental impact evaluation that will introduce them to the need to consider balancing costs with benefits, both financial and ethical.

Suggested approaches:

- A good way to start would be to ask students to compose a simple poster of all the information, experience and evidence they have amassed so far regarding our interaction with the environment. Encourage them to use the video links provided in the resources list below.
- A hint could be dropped as to the possibility of using what they know already about coal and wind as a checklist for other resources.
- Give the students the activity sheet **D2 WORKSHEET C: WIND AND COAL – THE ENVIRONMENTAL IMPACT** and let them work in pairs to complete it.

Resources:

- The Environmental Protection Agency (EPA) has posted Eco Eye videos looking at six key environmental topics. This might be useful to show to the class at the outset of this lesson.
- The EPA website also has a wealth of resources for further work in this area.

NOTE:

Energy in Action is an online schools resource from SEAI.
If you're reading a printout and wish to view this online to access links, visit www.seai.ie/energyinaction

D2 WORKSHEET C: WIND AND COAL – THE ENVIRONMENTAL IMPACT

Whenever something is built it has an effect on the environment, which is the world around us. In the past, people did not worry too much about the environmental consequences of their actions. If they cut down a forest there was always another one. They believed that there would always be plenty more fish in the sea.

By now, most people have realised that we must make sure that the damage or cost of building or using something is less than the benefits of that building or use. To work out if the costs or problems are greater than the benefits, an environmental impact study is carried out.

Using the table below, you are asked to make an environmental impact study. From the two lists you have already made,

1. Decide which of these are costs and which are benefits.
2. Write each cost and benefit into the correct space.
3. When you have finished, decide which source of energy has the most benefits and the lowest environmental costs or problems.
4. You should repeat this exercise for oil, nuclear, biomass, water and geothermal sources of energy

	BENEFITS	COSTS/PROBLEMS
Wind farm		
Coal-fired power station		
Oil		
Nuclear		
Biomass		
Water		
Geothermal energy		

D3: CUTTING GREENHOUSE GAS EMISSIONS

Overview

The purpose of this topic is to heighten the students' awareness of current greenhouse gas emissions and teach them how these emissions can be reduced to sustain the environment we need for living. The importance of managing our resources is also the theme of **STRAND A: ENERGY AND SUSTAINABILITY**.

Background information gives the students an appreciation of the global consequences of local actions. This section is research based; students use data to calculate different possibilities for reducing greenhouse gas emissions and then present the findings as recommendations.

Suggested approaches:

- As there is so much background information and data available, it is best to concentrate on the aspects most relevant to the students' lives.
- A short brainstorming session can be carried out to give you an idea of the awareness levels of the class.
- Divide the class into groups and assign relevant fact-sheets from the resources provided in this section. Ask each group to summarise what they have learned and present their findings to the whole class.
- Print the activity sheet cited in the resources section. Distribute it to the students after the brainstorming and fact-sheet sessions and ask them to complete it.
- Alternatively divide the class into groups and start with the activity sheet.

Resources:

- Visit the EPA website for information on Climate and what is being done and what you can do.
- See the EPA's information on Greenhouse Gas.
- The Live Science website examines the sources of greenhouse gases and their impact on solar radiation, global warming and climate change.

D4: SMART PACKAGING

Overview

The aim of this activity is to illustrate the importance of **recycling** and the practical realities of waste disposal. Students learn how some types of waste break down quicker than others, and discover the impact that our waste disposal has on the environment. The activity gives them a chance to investigate the different **biodegradabilities** and **polluting effects** of the waste that they produce.

Smart packaging is not **solely** about the **environmentally friendly** disposal of packaging. It is also about using packaging to **enhance the shelf life** of locally produced foods. In this way, smart packaging should contribute to supporting locally produced food rather than sustaining a dependence on imports. The **connection** between **smart packaging** and the **agrifood market** is perhaps an aspect that students may not be aware of. This activity is an opportunity for them to research it.

Suggested approaches:

- Arrange students into small groups and ask them to build up their knowledge about recycling and waste disposal using the resources provided. The next step will be **D4 ACTIVITY 1: SMART PACKAGING**, in which students build a small compost bin and monitor the breakdown of the contents over a period of time.
- Alternatively, the compost bin can be built and monitored as described in **D4 ACTIVITY 1: SMART PACKAGING** first, and then students can consolidate their findings using the resources provided.
- Ask students to compare the time scale of the biodegradability of a selected number of bags with the time scale advertised. For example if the bag is labelled as breaking down in ten to fourteen days, put it to the test. Has it really broken down within that time?
- Set students the task of researching the connection between smart packaging and the agrifood business, and comparing Ireland's packaging performance with that of other countries that supply food to us.

Resources:

- Click here to view an interesting Irish Examiner article on smart packaging.
- The EPA has great educational resources containing useful videos and exercises for students.
- Check out more information on recycling in Ireland.

D4 ACTIVITY 1: SMART PACKAGING

Background

The aim of this activity is to investigate the problems associated with excess packaging and waste going into landfills.

Suggested approach:

- Depending on the class, using worms could cause disruption and some students may be reluctant to participate. It is possible to do the investigation as a class demonstration instead if this is more suitable for the class.

Equipment required:

- A glass or clear plastic container (at least 35 cm deep)
- Cardboard to cover the container
- Soil
- Sand
- Worms
- Potato peels
- Newspaper
- Biodegradable plastic, e.g. biodegradable bin liners
- Plastic wrapping
- Dry leaves
- Two markers suitable for writing on plastic (e.g. CD pen) each of a different colour
- Biro, pointed screwdriver or metal skewer (to punch holes in the cardboard)

What to do:

1. Fill the glass or plastic container with layers of sand and soil until they are approx. 7 cm from the top of the container.
2. At different points between these layers, place the potato peels, newspaper, biodegradable plastic and plastic wrapping. It is important that the plastic wrapping is not layered across the soil, preventing the worms from getting through.
3. Using a marker, record on the outside of the container the location of each of the materials listed.
4. Cover the top of the container with dry leaves.
5. Scatter some worms from the garden on top of the leaves.
6. Using a biro, make a number of air holes on a sheet of cardboard and use it to cover the container.
7. Take a photo or draw a diagram of the container, showing where all the materials are located.
8. Surround the container with a black bag.
9. Leave the container in a warm, dry place for two weeks.
10. After two weeks, remove the packaging and have a look at all the materials.

    ? ***Is everything in the same place?***
11. With a different coloured marker, mark where the materials are. Write a description of what has happened to each material.
12. Continue to monitor the compost for as long as possible, and graph the results.

Resources:

- View appropriate videos and exercises for students from the EPA website.
- Information on the life cycle of plastics.

D5: SOLAR ENERGY

Overview

In this activity, the students learn the essentials about solar energy by making their own solar powered heater. It is a good follow up to activities students may have previously carried out in **B5 ACTIVITY 1 (I): WHAT COLOUR SURFACES ABSORB HEAT?**

Suggested approaches:

- Recap on earlier activities from **B5: HEAT ENERGY BY RADIATION**.
- Ask the students to outline the function of each of the items listed for making a solar heater before constructing it.
- Have the students draw up a flow chart indicating the role of each of the items to be used in constructing the heater. This will make the construction more interesting and easier to 'fault-find' if it malfunctions.
- Alternatively, let students construct the heater and then assign a functional role to each item.
- Once the 'solar heater' is registering temperature, pose some questions:
  - ? ***Does the temperature of the water in both bowls change?***
  - ? ***Why is this?***
  - ? ***Which bowl records the highest water temperature?***
  - ? ***How is the solar powered water heater helping to increase the temperature?***

Resources:

- The SEAI website has information on the use of Solar Energy for solar heat and solar electricity.
- SEAI has information on other sources of renewable energy.

D5 ACTIVITY 1: SOLAR ENERGY

Background

How can we design and make solar panels?

Equipment required:

- Two wash basins
- Three small white bowls
- Water
- Three thermometers
- Cling film
- Tin foil
- One small tin of black gloss paint
- One small tin of black matt paint

What to do:

1. Paint one bowl with black matt paint, the other one with black gloss paint. Leave the third unpainted.
2. Line the inside of each wash basin with tin foil.
3. When the paint is dry place the same quantity of water from the cold tap in all three bowls and leave them outside in direct sunlight for three minutes.

   ? ***Ask the students to guess why you are doing this.***
4. Take a note of the temperatures of the water in the three bowls.
5. Place the bowl painted with the matt paint in one wash basin and the bowl painted with the gloss paint in the other basin. Place the third bowl in the open air beside it.

   ? ***Ask the students to guess the purpose of this bowl.***

   Remember, all three bowls should be placed in direct sunlight.
6. Using cling film, tightly cover the top of the wash basins containing the black painted bowls so that no air can get in.

   ? ***Ask the students to guess why you have done this.***

   ? ***What difference would it make if air got in?***
7. Record the temperature in both bowls at 15-minute intervals for a double class or throughout one day.
8. Graph the temperature changes on a chart.

D5.1 DISCUSSION POINTS: SOLAR ENERGY

Comment on the graph drawn.

? ***What information did it contain?***

? ***Were you surprised by the outcomes?***

? ***Was there any difference in the temperature readings between the bowl painted with a matt finish and the bowl painted with a gloss finish?***

Resources:

- SEAI solar heat information.