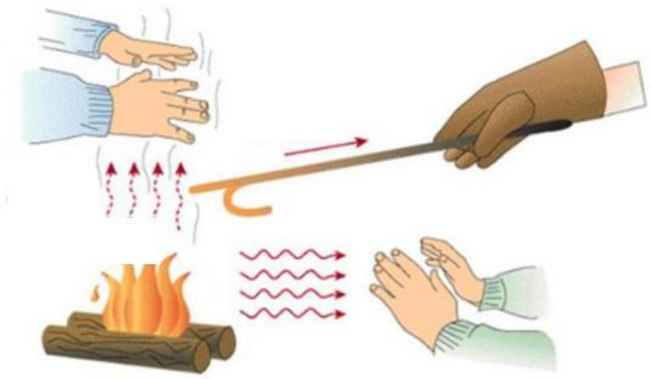
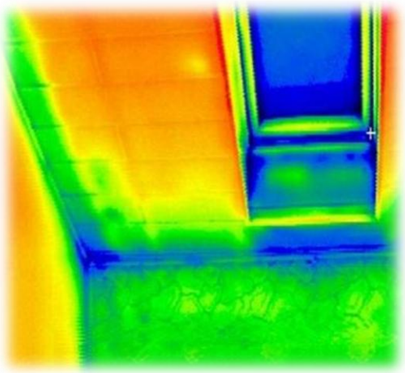
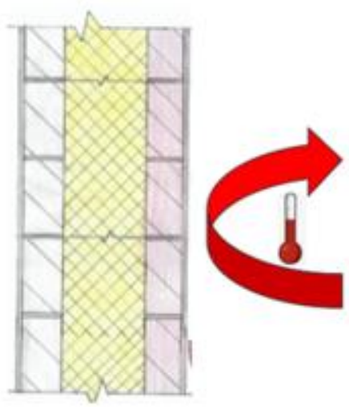




Describe what you see...



Activity 1: Fundamental Principles of Construction

3.5 identify elements of building fabric and their function in a domestic dwelling.
4.6 describe measures used to enhance the energy efficiency of new and existing dwellings.
4.8 explore airtightness standards, methods, materials and testing for a domestic dwelling.

Airtightness

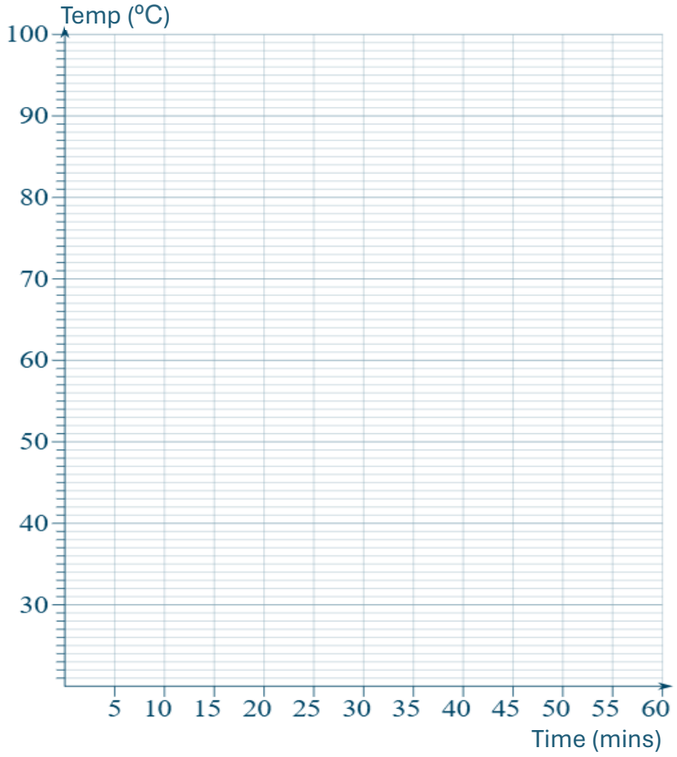
Instructions:

1. Fill the containers with hot water.
2. Measure and record the initial temperature of the water.
3. Cover one container to make it airtight, leaving the other container uncovered.
4. Using an instant-read thermometer, measure the temperature changes in both containers at 5 or 10-minute intervals.

Initial Water Temp: _____ºC

5. Record the temperature changes observed in the two containers in the table and plot the heat loss of both containers on the graph.

Time Interval (mins)	Airtight Container ºC	Open Container ºC	Temperature Difference ºC
0 mins (Start)	_____ºC	_____ºC	_____ºC



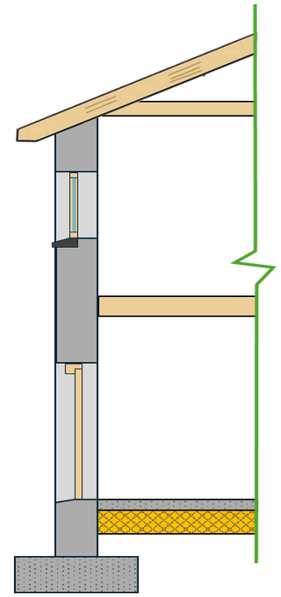
6. Answer the following questions:

i. Why do you think there is a difference in heat loss between the two containers?

ii. Outline the benefits of an airtight building fabric.

7. Research & Investigation:

i. On the image, highlight the areas of the building fabric where air leakage is likely to occur.



ii. Name and sketch two materials that are used to improve airtightness in a building fabric.

iii. Using notes and sketches, describe a test to measure the airtightness of a building fabric.

Activity 2: Fundamental Principles of Construction

2.18 use a variety of presentation techniques and technologies to communicate ideas, thinking, and technical information to complete tasks.
3.1 analyse the important principles in the design of the building fabric.
3.5 identify elements of building fabric and their function in a domestic dwelling.
4.3 explain the principles of heat transfer.
4.4 describe how thermal properties impact the energy efficiency of a dwelling.
4.6 describe measures used to enhance the energy efficiency of new and existing dwellings.

Thermal Conductance and Thermal Bridging

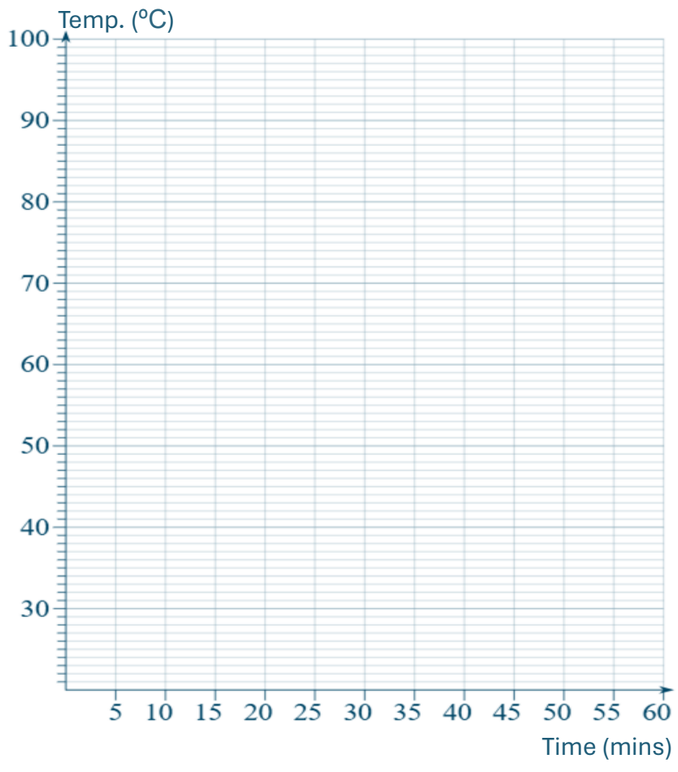
Instructions:

1. Fill the containers, surrounded with different materials, with hot water.
2. Measure and record initial water temperature.
3. Using the instant-read thermometer, measure the temperature changes in the three containers at 5 or 10-minute intervals.

Initial Water Temp: _____°C

4. Record the temperature of each container in the table, and plot the heat loss of the containers in the graph.

Time Interval	1. Container in Air (°C)	2. Container in Concrete (°C)	3. Container in Expanded Polyurethane (°C)
0 mins (Start)	_____°C	_____°C	_____°C



5. Answer the following questions:

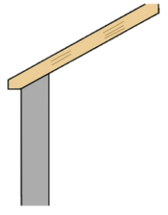
i. Which material would make the building fabric more energy efficient, and why?

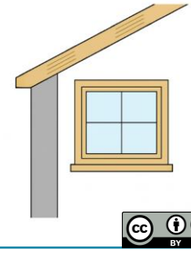
ii. Explain why the thermal performance of Concrete compared to Insulation might impact the energy efficiency of a dwelling.

6. Describe the effects thermal bridging may have on a building fabric, with reference to the following:

- comfort
- energy use
- condition of the building fabric.

7. Using notes and sketches, explore how a combination of materials can prevent heat loss through thermal bridging in the examples below.





Activity 3: A pedagogical approach grounded in hands-on learning

1.3. evaluate features that contribute to design excellence in housing design.
2.18. use a variety of presentation techniques and technologies to communicate ideas, thinking, and technical information to complete tasks.
4.4. describe how thermal properties impact the energy efficiency of a dwelling.
4.6 describe measures used to enhance the energy efficiency of new and existing dwellings.

Thermal Conductance and Thermal Bridging

1. Measure the ambient temperature of the room, using the appropriate thermometer, to establish a reference temperature and record it

$T_{Reference}$: ____ºC

Instant Read Thermometer

Optical Pyrometer

2. Choose an Element of the Building Fabric.

Identify and label the various component parts, and record their temperatures, with the use of a neat annotated sketch.

3. Fill in the table below, and calculate the temperature difference for various component parts of your chosen building element.

Component Part	Material	Temp Difference (ºC)
Example: Door Frame	*Timber*	*21-18 = 3 ºC*

Use the formula: $(T_{Reference} - T_{Element} = T_{Difference})$

4. Answer the following questions.

i. Describe how the thermal properties of the materials you measured might impact the energy efficiency of a dwelling.

ii. What is happening in the images shown?

iii. Based on your analysis, illustrate what measures could be taken to enhance the energy efficiency of the building fabric detail you measured?

Activity 4: Direct interaction with materials, tools, or environments

4.8 explore airtightness standards, methods, materials and testing for a domestic dwelling.
1.12 apply current health and safety protocols including the appropriate use of Personal Protection Equipment.
2.18 use a variety of presentation techniques and technologies to communicate ideas, thinking, and technical information to complete tasks.

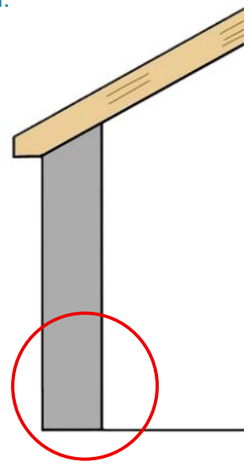
Airtightness

1. Identify the tools in this activity and outline a safety precaution for each.

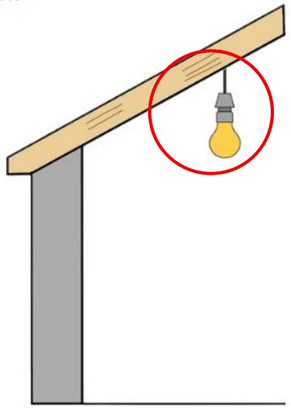
_____
_____
_____

_____
_____
_____

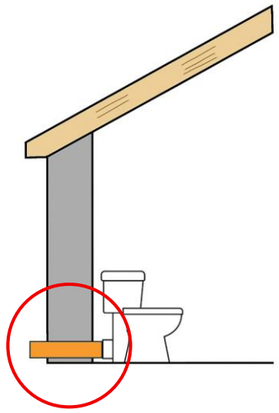
2. Using notes and freehand annotated sketches, show best practice design detailing to prevent air leakage in the corner shown in the illustration.



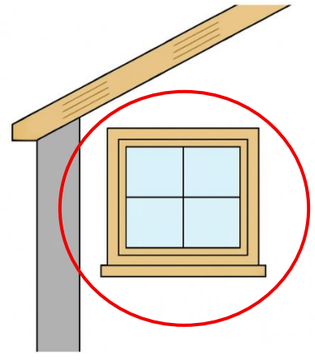
3. Using notes and freehand annotated sketches, show best practice design detailing to prevent air leakage around the electrical cable shown.



4. Using notes and freehand annotated sketches, show best practice to prevent air leakage around the foul waste pipe shown.



5. Using notes and freehand annotated sketches, show best practice to prevent air leakage around the window frame shown.



6. What are the advantages of achieving high levels of airtightness in a dwelling?

7. Discuss how airtightness can contribute to the environmental impact of a dwelling.

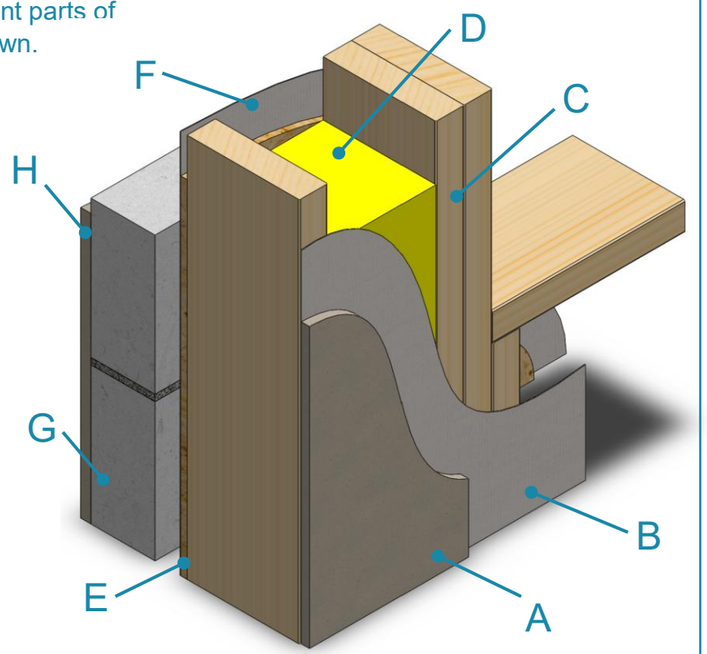
Activity 5: Apply theoretical knowledge to real-world situations

4.4 describe how thermal properties impact the energy efficiency of a dwelling.
4.5 calculate U-value of domestic construction details and the rate, amount, and cost of energy loss in a dwelling.

Heat Loss through Materials

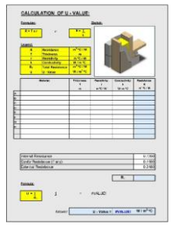
1. List the materials for the component parts of the external timber frame wall shown.

	Material
A	
B	
C	
D	
E	
F	
G	
H	



2. Input the above materials into the "U-value Calculator" Excel file, along with their thicknesses and conductivity values, and calculate the U-value of the external wall.

(Thickness and conductivity values will be provided by your teacher)



U-value of external timber frame wall: _____ W / m² ºC

3. What effect does changing the thickness of the insulation have on the U-Value?

4. What effect does changing the type of insulation (with a different conductivity) have on the U-Value?

5. Research – What is the maximum U-value allowed for an external wall in the Irish Building Regulations?

_____ W / m² ºC

(See: *Technical Guidance Document L, Building Regulations, 2022*)

6. Examine the sample insulation materials and record the effect they have on the U-value of the external wall.

Insulation Type	Thickness (T) m	Conductivity (k) W / m ºC	Resistance (R) m² ºC / W	New U-value W / m² ºC

7. After examining the sample insulation materials, choose a suitable type of insulation and appropriate thickness to use in the wall so that the U-value is below the maximum U-value allowed in the Building Regulations.

Chosen Insulation Type	Thickness Needed (T) m	Conductivity (k) W / m ºC

8. Record the data of the wall detail that adheres to the current building regulations, in the table below.

	Material	Thickness (T) m	Resistivity (r) m ºC / W	Conductivity (k) W / m ºC	Resistance (R) m² ºC / W
	Internal Surface				0.1300
A					
B		Ignore: as values are negligible			
C		The timber studs need not be considered in your calculations			
D					
E					
F		Ignore: as values are negligible			
	Cavity				0.4400
G					
H					
	External Surface				0.0480
				Resistance Total (R_T) =	
				U-Value = 1 / R_T = _____ W / m² ºC	

9. Research & Investigation:

Discuss how a U-value can impact a dwelling under the following headings:

- thermal comfort
- energy efficiency/usage
- environmental sustainability