

## 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.
  - ① *Which one would be good to install and why?*
  - ② *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?
  - ③ *What values do they represent?*
  - ④ *What do these values relate to?*
  - ⑤ *Who might use them?*
  - ⑥ *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.
  - ① *How do they compare?*
  - ② *Which window do you think has the better U-value?*
  - ③ *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.