

# Thermochromic Phone Case



Erasmus+

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**i) Introduction:**

**A) Thermochromic materials:** Thermochromic materials are materials that change colour when a certain temperature has been reached. During these experiments thermochromic ink was painted on a hard plastic phone cases and used to determine an increase in the mobile phones temperature. The experiment was carried out between November 2015 and January 2016.

**B) Key words:** Thermochromic ink, critical temperature

**C) Syllabus:** See vii – Relevance to Syllabus - Ireland

**D) Length of module:** 4 classes

Class 1 – Thermochromic materials

Class 2 – Design and manufacture of phone case

Class 3 – Results

Class 4 – Evaluation of results.

**ii) Materials:**

Paint brush , plastic tray (all purchased in DIY store), hard plastic mobile phone case (purchased from mobile phone shop), thermochromic ink (31°C) (purchased from [www.colourchanging.co.uk](http://www.colourchanging.co.uk) ), Samsung Galaxy Core prime model mobile phone.

**iii) Method:**

- 1) Black Thermochromic ink was mixed with the binder at the recommended rate (see packaging)
- 2) This was applied evenly using a small brush to a section of the back of the plastic phone case



- 3) This was allowed to dry in a cool dark room for one week before any experimental work took place.
- 4) The hard plastic phone case was placed carefully on the back of the Samsung Galaxy Core prime mobile phone.
- 5) Bluetooth, mobile data and the app You Tube were turned on
- 6) Results were recorded every 10 minutes

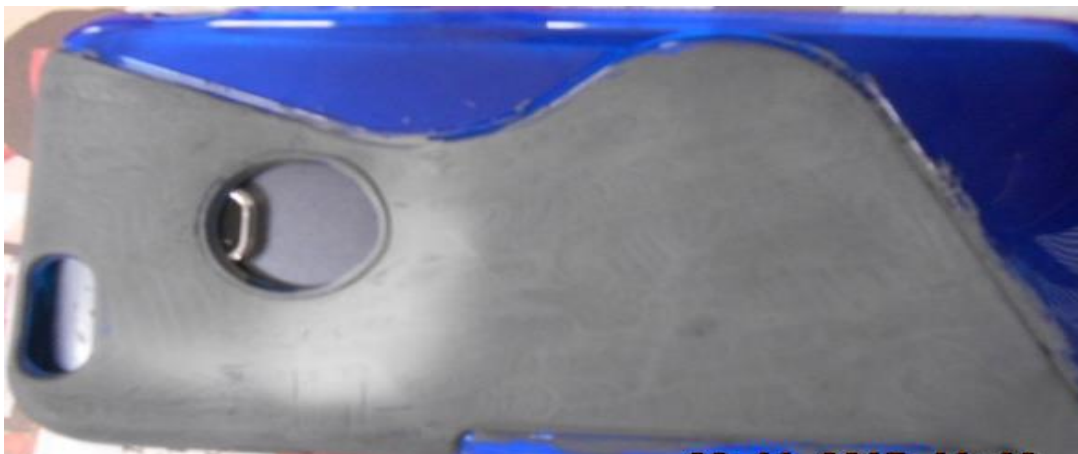
**iv) Results:** Colour to change from black to clear above temperatures of 31°C

Time (mins)	Colour Change	Touch Temperature
0	None	Cool
10	Slight	Cool
20	Visible	Cool
30	Clearly Visible	Slightly Warm

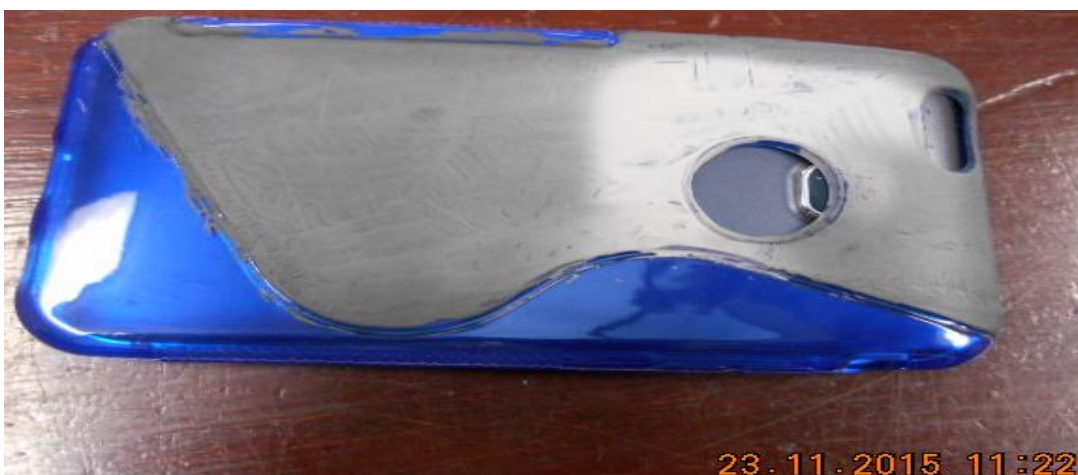
Time (mins)	Colour Change	Touch Temperature
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Time (mins)	Colour Change	Touch Temperature
20	Visible	Cool



Time (mins)	Colour Change	Touch Temperature
30	Clearly Visible	Slightly Warm



**v) Conclusion:**

After 30 minutes the black thermochromic ink was clearly changing to a light colour. This identifies that its critical temperature of 31°C had been reached by certain parts of the phone, notably around the camera lens, and was continuing to change colour over the rest of the phone case. The temperature of the phone case was considered only slightly warm at this stage. This indicates that when a person's mobile phone feels hot, the temperature of the phone is certainly above 31 °C. Prolonged high temperatures can have detrimental effects on battery and phone longevity. During this experiment Blue Tooth and Mobile Data were turned on and the app YouTube was running in the background. No text messages or phone calls were made or received during this period.

**vi) Further research:**

This research was limited to a Samsung Galaxy Core prime model mobile phone and a simple hard plastic phone case. Further research could look at other models of mobile phones, particularly ones where users have felt the phone is hot to touch, even after minimal use. Furthermore, other types of phone cases could be used, rather than a simple hard plastic one. This research has shown that even after a short period of time, thermochromic ink will start to reach its critical temperature on a hard plastic case and a change in colour will be clearly visible, even with limited mobile phone use.

**vii) Relevance to syllabus – Ireland.**

**Relevance to Thermochromic materials highlighted in green**

1) Junior Certificate Science

**5.3 Physics**

Physics is involved in most of the everyday applications of science and technology that we meet in our daily lives, in work, medicine, entertainment and in the home. While physics is principally concerned with the laws and relationships that govern our world, it also provides interesting insights into how things work and contributes to the development of problem-solving skills.

- Section 3A: Force and energy

- Section 3B: Heat, light and sound
- Section 3C: Magnetism, electricity and electronics

**Particular relevance to material highlighted in green above**

Section 3B2	
Heat transfer	conduction, convection and radiation; heat energy and temperature; insulation

2) Leaving Certificate Physics

**Relevance to Thermo-chromic materials highlighted in green**

Ordinary Level	Higher Level
Mechanics	Mechanics
Temperature	Temperature
Heat	Heat
Waves	Waves
Vibrations and Sound	Vibrations and Sound
Light	Light
Electricity	Electricity
Modern Physics	Modern Physics
	Option 1: Particle Physics
	Option 2: Applied Electricity

**Particular relevance to material highlighted in green above**

Ordinary Level	Higher Level
<b>Temperature:</b>	<b>Temperature:</b>
1) Concept of temperature	1) Concept of temperature
2) Thermometric properties	2) Thermometric properties
3) Thermometers	3) Thermometers
<b>Heat:</b>	<b>Heat:</b>
1) Concept of heat	1) Concept of heat