## Teacher and Technician Sheet

In this practical students will:

- Produce Blueprint paper.
- Create an image or diagram on Blueprint paper.
- Investigate the process of producing Blueprints and the role UV light plays.

**Introduction:**

(The topic could start with a group discussion during which teachers introduce the following ideas, especially the words in bold.)

A **blueprint** is an old term used for a reproduction of a technical drawing of an object such as an architectural or engineering design. They were made by a contact process using **light-sensitive** sheets. It was important because it allowed the rapid and accurate reproduction of design documents. It was called a blueprint because of the light lines on a blue background, forming a **negative** of the original.

Paper was frequently used but for more durable prints linen was sometimes used. Sadly, over time the linen prints would shrink slightly, so later imitation vellum and polyester film were used instead. Nowadays drawings are produced on computer, printed, and then photocopied.

These blueprint papers have **absorbed** certain chemicals that are changed when visible light or **ultraviolet (UV) light** falls on them. Hence objects put onto the dried blueprinting paper will block visible or UV light from getting to the chemicals and those areas, untouched by the visible or UV light, stay unchanged.

Where the visible or UV light can get to the paper, an intense blue colour develops. The blue colour will not wash out of the paper, but the greenish colour left under the object will. This leaves a white image of the object on a blue background. It is possible to investigate the effects of differing **exposure times**, **screening** with certain materials.

(To make the process easier for the students and safer the two solutions can be made up in the dark and stored in dark bottles.)

(This practical can be done with pupils working as individuals or in groups of two. Groups of two allows for good discussion between the pupils. Teachers can use the questions set as the stimulus for discussion and the answers can be used as a group report, article, presentation, poster or talk.)

**Curriculum range:**

Suitable for middle school or lower secondary students; it links with:

- ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience;

- use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety;
- make and record observations and measurements using a range of methods for different investigations; and evaluate the reliability of methods and suggest possible improvements;
- present observations and data using appropriate methods, including tables and graphs;
- interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions;
- present reasoned explanations, including explaining data in relation to predictions and hypotheses;
- the concept of a pure substance;
- mixtures, including dissolving.

**Hazard warnings:**

Potassium hexacyanoferrate(III) – Skin/eye irritant, (Cat 2) Respiratory irritant (STOT SE3)
Ammonium iron(III) citrate – Skin/eye irritant, (Cat 2)

Good practice would require exposure to be kept to a minimum and suitable gloves be used by the students. Students with impaired respiratory function may incur further disability if excessive concentrations of particulate are inhaled so good ventilation is required.

In addition, contact with strong acids causes the release of highly toxic hydrogen cyanide. This is not likely to be an issue but care should be taken on disposal to ensure that the drain/sink does not have acid already present.

Ammonium iron(III) citrate is slightly hazardous as an irritant through skin or eye contact.

**Wear safety glasses. Wear disposable gloves.**

**Equipment:**

For a group of students:

- 1 beaker (250 $cm^3$)
- 2 beakers (100 $cm^3$)
- 1 measuring cylinder (100 $cm^3$)
- 2 glass stirring rods
- 1 plastic tray
- 1 wash bottle containing distilled water
- 20 sheets (or access to) plain A4 paper (avoid shiny or very absorbent papers)
- 2 weighing boats (or gallipots)

- 2 spatulas
- 10 g potassium hexacyanoferrate(III) – labelled “Substance A – Irritant”
- 15 g ammonium iron(III) citrate – labelled “Substance B – Irritant”
- 1 drying line with 2 bulldog clips (or string and pegs)

**Access to:**

Marker pen

A4 paper

1 digital balance

Drying line (string and pegs)

Paper towelling

Disposable gloves

Newspaper (to cover the work area)

**Technical notes:**

If available use a fume cupboard to hang the string lines up in ready to peg the paper to dry and close any blinds near it.

It is possible to dry the prepared sheets more quickly by using radiators and/or hairdryers if available, but otherwise this practical would have to be carried out over two lessons to allow for drying time.

The amount of pages that can be hung out to dry is limited by the amount of space available.

Laminating sheets can be drawn on and placed onto the prepared sheets before placing in bright light to leave an imprint on the paper.

An alternative is to get pupils to use image editing software to produce a negative of their choice that can then be printed out on transparency film.

The paper may stain yellow and dry yellow, but it will still change colour when exposed to bright light and develop a blueprint when washed with water.

**Results:**

This practical works well in normal daylight with the internal lights switched off.

The amount of space to dry the papers directs how many sheets can be used in a practical.

Good results can be obtained using ordinary A4 paper and using laminating sheets to draw on.

Any shadows will also be processed on the paper so try to place the paper where it is in direct light and is laid flat.

The amount of chemicals used and solution produced could be halved and still cover about 10 sides of A4.

The hazards are minimal assuming the expected level of behaviour from students.