Student Sheet

In this practical I will be:

- Carrying out an experiment to produce Blueprint paper.
- Producing an image or diagram on my Blueprint paper.
- Investigating the process of producing Blueprints and the role UV light plays.

Introduction:

While on a school trip, you saw that some renovation work was being carried out by some builders. On a table were the Blueprints for the building. You realise that the shades of white and blue would be perfect for a piece of art you are currently working on. However, before you can use these shades, you need to understand how they are made. You decide to investigate further…

Equipment:

- 1 beaker (250 cm^3)
- 2 beakers (100 cm^3)
- 1 measuring cylinder (100 cm^3)
- 1 glass stirring rod
- 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
- Potassium hexacyanoferrate(III) – labelled “Substance A – **Irritant**” (low hazard)
- Ammonium iron(III) citrate – labelled “Substance B” (low hazard)
- 1 drying line with 2 bulldog clips (or string and pegs)

Access to:

Marker pen

A4 paper

Digital balance

Drying line (string and pegs)

Paper towelling

Disposable gloves

Newspaper (to cover the work area)

Method:

Making the blueprint paper

Wear gloves and goggles.

1. Get two 100 cm^3 beakers, a measuring cylinder and a stirring rod. Mark one beaker A and the other B.
2. Weigh 5 g of Substance A into the beaker marked A.
3. Now weigh 9 g of Substance B into the beaker marked B.

Use the measuring cylinder to measure 50 cm^3 of water and pour the water into beaker A.

4. Stir carefully until all the crystals have dissolved.
5. Now measure out another 50 cm^3 of water and pour into beaker B.
6. Stir carefully with a clean glass rod until all the crystals have dissolved.
7. Do steps 10–12 in a dark part of the lab.
8. Mix the two liquids together, and pour them into a tray. Move the tray gently to get the liquid to cover the base of the tray properly.
9. Put a piece of white A4 paper into the liquid just long enough to get it damp - not wet! Place a piece of A4 paper onto the liquid in the tray, then lift the paper out of the tray by the two corners nearest to you. Allow the excess solution to drip into the tray before placing it wet side up onto some newspaper on a desk.

   Your paper will turn greenish blue. Hang it up to dry out in a dark part of the laboratory or store it lying flat in a dark drawer. Hang your paper up using the string line and pegs in a darkened area to dry.

10. The paper must be dry since the experiment will not work with wet or damp paper.

- Why do you think you have to wear gloves and goggles?
- What does dissolve mean?
- Why do you think the mixing has to be carried out in a dark place?
- Why do think the experiment will not work if the paper is wet?

Making the blueprints:

Wear disposable plastic gloves

1. When dry place your prepared paper under another piece of paper to keep it away from the sun.
2. Place the package by the window so the light can fall on it.
3. Remove the protecting piece of paper and place an object on the surface.

4. Leave it in the light for about 1–5 minutes. Longer exposure leaves a shadow; shorter exposure times produce a sharper image.
5. When you think it has gone blue enough, take the object off the paper. The covered parts will still be green.
6. Wash the paper with water to wash away the green chemicals and leave the blue behind.
7. Hang your blueprint up to dry out.
8. Wash your hands carefully.

- Why does your prepared blueprint paper need to be kept in the dark?
- Does the paper change colour quickly when it is exposed to the light?
- What does the washing do to the paper?
- Why do you have to wash your hands at the end?

Going further:

Try a range of different types of paper to see if the paper type makes a difference to exposure time, depth of exposure, etc.

If you can get some old black and white negatives try using those on the blueprint paper. You will have to experiment with exposure times.

Describe how the blueprint paper is similar and how different it is to photographic developing with a film. Research the chemicals used in photography.

Theory:

Blueprints use the cyanotype process invented by the astronomer John Herschel in 1842. The paper is coated with a solution of two soluble iron(III) salts - potassium hexacyanoferrate(III) (potassium ferricyanide) and iron(III) ammonium citrate.

The two iron salts do not react with each other in the dark, but when they are exposed to ultraviolet light the iron(III) ammonium citrate becomes an iron(II) salt. The iron(II) ion reacts with the potassium ferricyanide to form an insoluble blue compound, blue iron(III) ferrocyanide, also known as Prussian blue.

A blueprint starts out as a black ink sketch on clear plastic or tracing paper. The ink sketch is laid on top of a sheet of blueprint paper and exposed to ultraviolet light or sunlight. Where the light strikes the paper, it turns blue. The black ink prevents the area under the drawing from turning blue. After exposure to UV light, the water-soluble chemicals are washed off the blueprint, leaving a white (or whatever colour the paper is) drawing on a blue background. The resulting blueprint is light-stable and as permanent as the substrate upon which it is printed.