# Chemical Pigments Experiment

## Key Stage 3

| | | |
|---|---|---|
| **Scheme of work unit:** | **7F** | Introduced to the idea that chemical change results in new substances that are different from the ones from which they were made. |
| | **7H** | Extend their knowledge of dissolving and the separation of components of a solution. |
| | **8F** | Distinguish between chemical reactions in which new compounds are formed and the formation of mixtures. |
| | **9H** | Consider how chemical reactions are used to make new materials. Represent chemical reactions by word and/or symbol equations. |
| **Intended learning:** | | Investigate the formation of a new pigment by reacting two solutions. Investigate how to separate the newly formed solid from the solution. Observe the gas emitted and effervescence that occurs when forming Malachite Green. Write balanced equations for the chemical process. |

**Introduction notes:**

- A pigment is a small particle that does not dissolve in water.
- Pigments can be natural or man-made.
- Malachite Green is a chemical that is primarily used as a dye.
- When diluted, it can be used as a topical antiseptic or to treat parasites, fungal infections, and bacterial infections in fish and fish eggs. It is also used as a bacteriological stain.
- Prussian Blue is a dark blue pigment used in paints and formerly in blueprints.
- Despite being one of the oldest known synthetic compounds, the composition of Prussian Blue was uncertain until recently. The precise identification was complicated by 3 factors:
- (i) Prussian Blue is extremely insoluble but also tends to form colloids (a suspension of particles in a liquid).
- (ii) Traditional syntheses tend to afford impure compositions.
- (iii) Even pure Prussian Blue is structurally complex, defying routine crystallographic analysis.
- The chemical formula of Prussian Blue is $Fe_7(CN_{18})(H_2O)_x$

**Resources required:**

- Burettes
- Funnels
- Filter papers
- Watch glasses
- Conical flasks
- Iron(III) chloride – $FeCl_3$
- Potassium ferrocyanide – $K_4[Fe(CN)_6]$
- Copper sulfate – $CuSO_4.5H_2O$
- Sodium carbonate - $Na_2CO_3$
- Cobalt chloride – $CoCl_2.6H_2O$
- Sodium phosphate – $Na_2HPO_4$

**Practical notes:**

The chemicals should not be ingested. Cobalt chloride is a listed carcinogen by inhalation, and therefore this solution should be prepared in advance. Dissolving 6g $CoCl_2.6H_2O$ per 250ml of water makes this. Gloves should be worn to prevent skin contact. Safety glasses and lab coats should be worn at all times.

Iron chloride – R22 38 41, S26 39
Potassium ferrocyanide – R32, S22 24/25
Prussian blue – S22 24/25
Copper sulfate – R22 36/28 50/53, S22 60 61
Sodium carbonate – R36, S22 26
Copper carbonate – R22 36/37/38, S26 36
Cobalt chloride – R49 22 42/43 50/53, S53 22 45 60 61
Disodium hydrogen phosphate –
Cobalt phosphate – R22 36/37/38 40 42/43, S26 36

**Answers:**

1. Iron, Copper and Cobalt.
2. Effervescence/fizzing
3. Carbon dioxide gas
4. **Prussian Blue**: $3K_4[Fe(CN)_6] + 4FeCl_3 \rightarrow Fe_4[Fe(CN)_6]_3 + 12KCl$
   **Malachite Green**: $2CuSO_4.5H_2O + Na_2CO_3 \rightarrow Cu_2CO_3(OH)_2 + 2NaSO_4 + 3H_2O + H_2$
   **Cobalt Violet:** $3CoCl_2.6H_2O + 2Na_2HPO_4 \rightarrow Co_3(PO_4)_2 + 4NaCl + 2HCl + 6H_2O$