**Chemistry Demonstrations for Primary School Students:**

**Overall Equipment List to bring with me from Chemistry:**

1 Litre measuring cylinder

1 x 25 mL measuring cylinders

~500 mL measuring cylinder

Plastic tray

Glass stirring rod

Funnel

1 x 1 L conical flask – solution A

2 x 250 mL plastic bottles – solutions B and C

Bottles with Hydrogen peroxide

2 Test tube racks

12 large test tubes

Black light light-box

1 M NaOH with dropper

1 M HCL with dropper

250 mL flask

ethanol (200 mL)

Phenolphthalein

Teepol

**Overall Shopping List**

Empty 1.25 L soft drink bottle

Dried Yeast (1 heaped teaspoon/ 1 sachet)

Sugar

Food colouring

Paper towels

Cotton buds/match sticks

Sheets of paper

Small plastic bottles

One spray bottle

Sponge

Red cabbage

Red roses or any bright coloured flower

Tea

Red wine

Vanilla essence

Turmeric

Plastic Cups

Balloons

Wooden skewers

Vegetable Oil

Salt

**1. Elephant’s toothpaste:**

Catalytic decomposition of H2O2 using MnO2/NaOH/detergent.

Demonstration 7.8

Equipment: 1 Litre measuring cylinder

25 mL measuring cylinder

plastic tray

glass stirring rod

Reagents: manganese dioxide, MnO2, 1 heaped nickel spoon full in sample jar

sodium hydroxide, NaOH (1 M, 20 mL)

hydrogen peroxide, H2O2 (30 % w/w, 30 mL) measured out and placed in an opaque H2O2 bottle.

Teepol (20 mL)

Preparation: Put large measuring cylinder in plastic tray

Use 25 mL measuring cylinder to measure out NaOH

Place MnO2, NaOH and Teepol in large measuring cylinder and stir

Procedure: Add H2O2

Results: The volume of foam depends on the strength of the H2O2

2H2O2 -> 2 H2O (l) + O2 (g)

Caution: NaOH is corrosive, avoid contact with skin. In case of contact with skin wash with plenty of water.

H2O2 is an oxidizing agent and is corrosive and can explode when heated. The required volume of 30 mL will be poured into an opaque bottle for transport. It will then be poured directly into the measuring cylinder for the experiment. Contact with skin will be avoided and eye protection will be worn. In case of contact with skin wash with plenty of water.

O2 is potentially explosive, perform experiment in a well ventilated area with no open flames.

Clean up: Mop up the foam with a paper towel and dispose of in garbage bin, cylinder and tray can be rinsed with water, which can be washed down the sink.

**1b Variation on Elephants toothpaste**

Equipment: Empty 1.25 L soft drink bottle

Plastic cup

Funnel

Plastic tray

Reagents: Dried Yeast (1 heaped teaspoon/ 1 sachet)

Sugar (1/4 teaspoon)

Warm Water (4 tablespoons)

Black or other colour food colouring (not cochineal)

Hydrogen Peroxide (6% 125 mL)

Teepol (20 mL)

Preparation: Put soft drink bottle in plastic tray

Place Black food colouring, Yeast, Sugar and warm water in plastic cup and stir, allow to rest for about 5 minutes

Pour H2O2 into soft drink bottle and add Teepol and food colouring, swirling to mix

Procedure: Use funnel to pour yeast solution into bottle.

Results: The volume of foam depends on the strength of the H2O2

2H2O2 -> 2 H2O (l) + O2 (g)

Caution: H2O2 is an oxidizing agent and is corrosive and can explode when heated, the more dilute solution is much safer.

O2 is potentially explosive, perform experiment in a well ventilated area with no open flames.

Clean up: Mop up the foam with a paper towel and dispose of in garbage bin, soft drink bottle and tray can be rinsed with water, which can be washed down the sink.

**2. The oscillating iodine reaction**

Three solutions are added together quickly, the resultant solution then oscillates between a golden colour, dark blue and colouless, finally stopping at a deep blue colour.

Demonstration 7.5, This experiment will be made at half the volumes of the lecture demonstrations

Equipment: 3 x 250 mL conical flasks + stoppers

2 x 250 mL plastic bottles

1 x 1 L conical flask

magnetic heater/stirrer and spin bar

long stirring rod

Reagents: potassium iodate, KIO3 (14.5 g - fresh)

sulfuric acid, H2SO4 [5 ml of 6M]

malonic acid, CH2(CO2H)2 (5.25 g)

manganese sulfate, MnSO4 .4H2O (1.1 g) or MnSO4 .H2O (0.84 g)

hydrogen peroxide, H2O2 (30 w/v%, 150 g - fresh)

Vitex (starch solution)

distilled water

Preparation:

**Solution A**; label the 1 L flask “A”

Put 350 mL distilled water in the flask

Place on a warm hotplate with stirring bar

Add KIO3 (14.5 g) and 6 M H2SO4 (5 mL) Stir to dissolution.

Remove from heat.

Make up to the 1Lmark with distilled water.

Stopper lightly.

Allow to cool

Seal with parafilm for transport

**Solution B**; label one 250 mL flask “B”

Mark at 250 mL

Put 200 mL distilled water in the flask

Add MnSO4 .4H2O (1.1 g), malonic acid (5.25 g) and half a nickel spoon of Vitex indicator

Stir to dissolve

Make up to 250 mL mark with distilled water and transfer to a plastic bottle labeled “B”.

**Solution C**; label one 250 mL flask “B”

Mark at 250 mL

Add H2O2 (30% 148.2 g) and make up to 250 mL with distilled water

Transfer to an opaque plastic bottle labeled “C” – an empty H2O2 bottle.

Procedure: Transfer solutions B and C into the 2 L flask, A

Results: Initially, the solution will be clear and colourless. After several seconds a rapid colour change to golden brown will occur. After several further seconds the solution will change to deep-blue, then colourless again. The above sequence should repeat itself up to 15 times before the solution settles to a permanent, deep blue.

The overall reaction is:

IO3– +2H2O2 +CH2(CO2H) +H+ -> ICH(CO2H) +2O2 +3H2O

Caution: The individual reagent solutions will be made in the Chemistry School and solutions B and C will be decanted into plastic bottles for transport. The made up concentrations of all reagents are very low, with the exception of H2O2, and do not constitute a hazard.

H2O2 is an oxidizing agent and is corrosive and can explode when heated. The required volume of solution C will be poured into an opaque bottle for transport and poured into the flask directly. Contact with skin will be avoided and eye protection will be worn. In case of contact with skin wash with plenty of water.

The O2 evolved is potentially explosive, perform experiment in a well ventilated area with no open flames.

Clean up: The reaction flask will be returned to the chemistry school and any I2 formed will be reduced to iodide by addition of sodium thiosulfate. The flask will be cooled, if necessary, and the cold solution can be flushed down the sink.

**3. Natural pH Indicators**

Demonstration 5.8 with the addition of vanilla and turmeric

Equipment: 2 Test tube racks

2 large test tubes for each indicator used, 12 total

250 mL flask

200 mL plastic Bottle

2 x plastic cups

Reagents: hydrochloric acid, HCl (1 M)

sodium hydroxide, NaOH (1 M)

ethanol (200 mL)

red cabbage

red roses or any bright coloured flower

tea

red wine

vanilla essence

turmeric

Preparation: Boil red cabbage in 200 mL of water to extract the purple colour and place in bottle for transport

Extract the pigment from the flowers by soaking them in ethanol for about half an hour in the 250 mL flask (do this at school, first, before the other demonstrations).

Dilute 30 mL of red wine 1:6 with water in a plastic cup.

Make a strong 200 mL cup of tea. Cool and place in plastic bottle.

Dissolve 2 teaspoons of turmeric in about 200 mL of water in plastic cup.

Pour some of each solution into each of the two test tubes.

Procedure Add a few drops of HCl to one test tube and a few drops of NaOH to the other

Results: Each of the pigments has a distinct alkaline and acid colour and can therefore be used as a pH indicator. Vanilla is an olfactory (ie smell) indicator. You can’t smell the vanilla in a basic solution because the vanillin molecule ionizes although you can smell it in a neutral or acidic solution

Caution: HCl and NaOH are corrosive, avoid contact with skin. In case of contact with skin wash with plenty of water.

Ethanol is volatile and flammable, perform in a well ventilated area with no open flames.

Clean up: All solutions can be flushed down the sink.

**4. Secret Writing**

Equipment: Cotton buds/ matchsticks

Sheets of paper

Plastic bottle

One spray bottle

One or two plastic cups

Sponge

Black light light-box

Reagents: Phenolpthalein indicator

Laundry detergent

Starch solution (vitex or rinse water from rice or potatoes or cornflour solution; 1 teaspoon of cornflour)

Tonic Water

I2 (about 1 nickel spoon full), or tincture of iodine (1 mL)

Water

Preparation: Put the vitex or starch solution into a plastic bottle.

If using corn flour, mix a teaspoon of corn flour with ¼ cup of cold water in plastic cup. Cook in a microwave for 1 minute, stirring after 15 seconds and at the end. Cool.

Dissolve some laundry powder in water in the spray bottle.

Dissolve the I2 in about 10-15 mL of water and put in the plastic cup.

Procedure: Use a cotton bud to write on the paper with the phenolphthalein, starch solution and tonic water. Let the paper dry.

“Develop” the writing, spraying with the laundry powder solution for the phenolphthalein to show pink writing and sponging over the I2 solution for the starch show blue writing.

The quinine in tonic water fluoresces and can be seen using the black light box.

Caution: Phenolphthalein is a possible carcinogen and is dissolved in methanol and ethanol, which are volatile and flammable. Gloves should be used and skin contact avoided. In case of contact with skin wash with plenty of water. Phenolphthalein writing will only be done by me, not the students, in a well ventilated area with no open flames.

Iodine is an antibacterial and can potentially stain skin and clothes. The iodine solution should not be drunk and gloves should be worn sponging the iodine over the paper.

Clean up: All solutions can be flushed down the sink.

**Awesome Balloon Experiment**

Equipment: Balloons

Wooden skewers

Vegetable Oil

Paper towels

Preparation: Inflate and tie off the balloons so that they are not too inflated

Tap the sharp pointed ends of the skewers on the table to slightly blunt them

Use the paper towel to coat the skewer with vegetable oil.

Procedure: **Slowly** twist the skewer through the very top of the balloon (where the balloon is thickest) using gentle twisting motion. Keep pushing and twisting until the skewer emerges near the balloon tie. Pull and twist the skewer out slowly through the tied end. As the skewer goes completely through the top hole the balloon will slowly deflate. After you’ve pulled the skewer out jab the balloon with it and it will pop. Alternately you can poke multiple skewers through the balloon.

Results: This demonstration indicates that the polymer chains that make up the balloon can rearrange themselves about the skewer, sealing the hole, as long as you move the skewer slowly. If you move it too fast (like when you pop the balloon at the end) there isn’t enough time to reseal the hole.

Caution: The skewers are sharp and can cause injury, do not let students play with them.

Clean up: All items can be disposed of in a garbage bin.

**Salt or Sugar Lava Lamp**

Equipment: Large glass or ~500 mL measuring cylinder

Reagents: Vegetable Oil

Salt or Sugar

Food Colouring

Water

Procedure: Pour about 5-10 cm of water into the glass or measuring cylinder.

Pour in about ½ cup vegetable oil.

Add a few drops of food colouring.

Sprinkle sugar or salt generously over the top.

Results: Oil is lighter and less dense than water so it floats. Water and oil are immiscible liquids. This means they don't mix and form separate layers. The food colouring is denser than the oil and so sinks through the oil before dissolving in the water underneath (some colours will have components that are soluble in the oil). Salt and sugar are heavier than water so when you pour them into the liquid, they sink to the bottom. As they sink, they carry a blob of oil with them. The sugar and salt then dissolve in the water and release the oil, and it floats back up to the top. As the oil blobs float back up to the top, this experiment looks very much like a lava lamp. A lava lamp however, contains hot wax which rises to the top of the lamp, cools and then falls.

Clean up: All items can be disposed of down the sink.