THE ELECTROSTATIC BUBBLE

CODE NAME Electrostatic attraction **DEMO #** Gen.1

REFERENCE Twenty Demonstrations Guaranteed to Knock Your Socks Off! Volume II, p. 11

EQUIPMENT balloon
bubble wand

CHEMICALS soap bubble solution

PROCEDURE Inflate the balloon and charge one side of it by rubbing it on some wool or someone's hair.

Blow a fist–sized bubble and as it slowly descends bring the charged balloon close to it, from above, and suspend the bubble in mid–air, balanced between the attraction of gravity and the electrostatic attraction to the balloon. **Note:** the bubbles work best if they are bigger and therefore slower to move either up or down. In addition, the first bubbles blown may be too heavy with excess liquid and will fall too quickly to be caught.

THE BUBBLE TRAMPOLINE

CODE NAME Electrostatic repulsion **DEMO #** Gen.2

REFERENCE Twenty Demonstrations Guaranteed to Knock Your Socks Off! Volume II, p. 12

EQUIPMENT bubble wand
coat hanger

CHEMICALS bubble solution
soapy water in a basin (about a 3–5% solution of dishwashing detergent)

PROCEDURE Bend the triangle of the coat hanger into a square shape.

Holding the coat hanger by the top loop, dip the square of the hanger in the soapy water and lift the hanger out vertically, creating a film across the frame.

Blow a fist–sized bubble with the bubble wand and as the bubble descends, bounce it back into the air with the soap film on the coat hanger. The flat soap film bulges down and inverts itself to bounce the bubble quite high (with practice).

Although the bubble and flat film appear to contact each other, the charges on the surface of the soap films have negative electrostatic charges distributed over them, causing a repulsion and preventing actual touching.

COMBUSTION OF CELLULOSE NITRATE (GUNCOTTON)

CODE NAME Guncotton **DEMO #** Gen.3

REFERENCE Chemical Demonstrations: A Handbook for Teachers of Chemistry, Vol 1: p. 43

EQUIPMENT
tongs
paper towels
250 mL beaker
ice bath

CHEMICALS
70 mL of concentrated sulphuric acid
30 mL of concentrated nitric acid
5 g of absorbent cotton batting
250 mL of 1 M sodium hydrogen carbonate, $NaHCO_3$

PROCEDURE Place a 250 mL beaker in an ice bath and add 70 mL of concentrated sulphuric acid and 30 mL of concentrated nitric acid to the beaker. Divide the cotton into pieces of about 0.7 g. Using tongs, immerse each piece of cotton in the acid mixture for about one minute. Next, rinse each piece of cotton in three successive 500 mL water baths. Use fresh water for each piece of cotton. Next immerse each piece of cotton in 250 mL of 1 M $NaHCO_3$. If substantial bubbling occurs, re–rinse in water and neutralize in $NaHCO_3$ again. Squeeze dry and spread on paper towel to dry overnight.

To demonstrate the burning of guncotton, light a candle or bunsen burner and, from a distance of at least 1 m, throw the guncotton into the flame. The guncotton burns instantly with a bright flash and leave a tiny residue of white ash.

Large amounts of guncotton should not be stored for any length of time.

BURNING WATER

CODE NAME Burning lighter fluid on water **DEMO #** Gen.4

REFERENCE Chemical Demonstrations: A Handbook for Teachers of Chemistry, Vol 2: p. 6

EQUIPMENT
500 mL erlenmeyer flask
match
water tap

CHEMICALS
cigarette lighter fluid (about one–half teaspoon)
stock bottle of sodium chloride
stock bottle of sodium hydrogen carbonate

PROCEDURE Shortly ahead of time, out of sight of students, squirt about one–half teaspoonful of cigarette lighter fluid into a 500 mL erlenmeyer flask and swirl the flask so as to evenly distribute the liquid over the inside surface of the flask and make the flask appear empty.

To perform the demo, bring out the equipment, take the flask and quickly fill it almost to the top with tap water, add a pinch of sodium chloride and a pinch of sodium hydrogen carbonate (for dramatic effect and as a distracter). By this time the lighter fluid will have floated to the top of the water. Light the “water” and note the smoky flame. Students can be left to guess why water seems to “burn”.

BENDING A STREAM OF WATER

CODE NAME Electrostatic attraction of water **DEMO #** Gen.5

REFERENCE Chemical Demonstrations: A Handbook for Teachers of Chemistry, Vol 2: p. 91

EQUIPMENT
2 –50 mL burettes, with double burette clamp and stand
2 – 400 mL beakers
rubber or plastic rod
piece of wool or fur

CHEMICALS
distilled water
hexane

PROCEDURE Fill one burette with hexane and one with distilled water.

Adjust the stopcock on the water burette to give a fine unbroken stream into a 400 mL beaker. Charge the rubber or plastic rod with a piece of wool or fur and show that water is attracted to the rod (don't let the water touch the rod).

Repeat with the burette containing hexane to show that hexane is not attracted to the rod.

Variation: Instead of a rubber or plastic rod, use a vinyl plastic strip charged with wool to show that water is attracted to a negative charge. Then use a piece of acetate plastic charged with a paper towel to show that water is attracted to a positive charge. This shows that water has both a positive and a negative end.

COLOURED H_2 BALLOON EXPLOSIONS

CODE NAME Fireworks flame tests **DEMO #** Gen.6

REFERENCE A Demo A Day: A Year of Chemical Demonstrations, p. 53

EQUIPMENT
4 – 9 inch round balloons
string
candle taped to a meter stick
matches
tape

CHEMICALS
hydrogen gas cylinder
strontium nitrate; one–half teaspoonful, powdered
copper (II) chloride; one–half teaspoonful, powdered
potassium chloride; one–half teaspoonful, powdered
iron; teaspoonful, one–half powdered

PROCEDURE Add the individual powders to different balloons. While wearing safety goggles, inflate each balloon to about 13 inch diameter with hydrogen gas and tie off securely. Attach a string and secure the balloons to the demonstration table with tape, such that each balloon is well separated from the others. The solid settles to the neck of the balloon. Warn spectators to wear safety glasses and cover their ears. Light the candle at the end of the meter stick and bring the candle near the NECK of each balloon. The resulting explosion takes on the colour of the chemical inside. Strontium gives a bright red, copper(II) chloride gives blue, potassium chloride gives purple–blue and iron gives a yellow sparkle. Avoid toxic salts such as barium and lithium, and definitely avoid aluminum due to the possibility of respiratory problems.

THE JUMPING FLAME

CODE NAME Flames in O_2 and CO_2 **DEMO #** Gen.7

REFERENCE A Demo A Day, Volume 2: Another Year of Chemical Demonstrations, p. 53

EQUIPMENT
2 – 1000 mL graduated cylinders
2 – long stirring rods
2 – long wooden splints
2 – scoops

CHEMICALS
one scoop of sodium hydrogen carbonate, $NaHCO_3$
250 mL of vinegar or 5% acetic acid
1/2 scoop of manganese dioxide, MnO_2
250 mL of 3% hydrogen peroxide

PROCEDURE Into the first 1000 mL graduated cylinder put 1/2 scoop of manganese dioxide and into the second graduated cylinder put one scoop of sodium hydrogen carbonate.

Pour 250 mL of 3% hydrogen peroxide into the first graduated cylinder and 250 mL of 5% acetic acid. Stir each mixture. Light the two splints and blow out one splint, leaving it glowing. Simultaneously plunge the burning splint into the cylinder containing carbon dioxide (sodium hydrogen carbonate and acetic acid) and the glowing splint into the cylinder containing oxygen (3% hydrogen peroxide and manganese dioxide). The flame goes out in the carbon dioxide and the glowing splint bursts into flame in the oxygen, so the flame appears to “jump” from one splint to the other. (This takes some practice.)

SAINT PATRICK'S DAY DEMO

CODE NAME Green boric acid flame **DEMO #** Gen.8

REFERENCE A Demo A Day, Volume 2: Another Year of Chemical Demonstrations, p. 61

EQUIPMENT
side arm vacuum filtration flask
Meker burner
one–hole rubber stopper to fit flask
glass gas delivery tube, to fit one–hole stopper
2 – pieces of rubber tubing, to fit glass and connect between gas outlet and bunsen burner

CHEMICALS
10 g of boric acid, H_3BO_3
100 mL of ethanol

PROCEDURE Stir 10 g of boric acid into 100 mL of ethanol (it doesn't completely dissolve). Set up the apparatus as follows. Insert the stopper into the 250 mL flask and insert the glass tubing such that the tube goes almost to the bottom of the flask. Connect a rubber tube from the gas outlet to the glass tube. Connect the flask side arm to the Meker burner using a second rubber tube.

Light the Meker burner. The flame has a green tint.

THE BALLOON IN THE FLASK — A NEW APPROACH

CODE NAME Ammonia fountain balloon in flask **DEMO #** Gen.9

REFERENCE A Demo A Day, Volume 2: Another Year of Chemical Demonstrations, p. 198

EQUIPMENT 500 or 100 mL round–bottom flask
large heavyweight balloon
one–hole stopper to fit flask
hot plate

CHEMICALS 50 mL of concentrated ammonium hydroxide

PROCEDURE Fill the flask with ammonia and cover the mouth with the stopper. Put 5–10 mL of water into the flask, pinch off the water inside the balloon and stretch the neck of the balloon over the mouth of the flask. Hold the balloon upright and release the water into the flask. The balloon is rapidly pushed into the flask.

DRAGON'S BREATH

CODE NAME Vaporizing ethanol into a flame **DEMO #** Gen.10

REFERENCE A Demonstration–a–Day **...** For High School Chemistry, p. 6

EQUIPMENT Candle taped to the end of a meter stick
matches
spray bottle

CHEMICALS ethanol

PROCEDURE Put about 50 mL of ethanol in the spray bottle. Hold a lit candle at arm's length. Hold the spray bottle about 4–6 inches from the candle and quickly spray ethanol through the flame. This should produce a nice little fireball that lasts for a second.

In 1991, US military forces in the Iraq War used fuel–air bombs. These bombs blew out a fine mist of gasoline–like fuel over a large area and then followed this with a small delayed action explosion that ignited the vaporized fuel. The large surface area of the resulting explosion created a devastation that exceeded a small tactical nuclear weapon. When these bombs were set off above a mine field, the pressure wave detonated every mine in the mine field.

DISAPPEARING ORANGEADE

CODE NAME Redissolving mercury complexes **DEMO #** Gen.11

REFERENCE Chem 13 News, November 1976, p. 6

EQUIPMENT 4–250 mL beakers

CHEMICALS mercury(II) nitrate = 6.0 g/L
potassium iodide = 15.0 g/L

PROCEDURE Pour about 50 mL of mercury(II) nitrate into a glass jar. Then pour about 150 mL of potassium iodide solution into a beaker and from it pour about 25 mL, while swirling, into the mercury(II) nitrate jar – turns orange. Ask if anyone wants a nice glass of orange juice, made with the best mercury compounds available – keep the beaker containing the potassium iodide in your hand, in visible view. When no-one takes up the offer, shrug and tell the audience that you will get rid of the orange juice – quickly pour the remaining 125 mL of the potassium iodide solution into the "orange juice" – the colour disappears.

***What is Happening*:**

When iodide ion is added to mercury(II) ion, a precipitate of solid HgI_2(s) is formed.
When even more iodide ions are added to the mixture, the colourless HgI_4^{2-} ion is formed (and the solid dissolves).

SILVER MIRROR

CODE NAME Reduction of silver by dextrose **DEMO #** Gen.12

REFERENCE Tested Demonstrations in Chemistry, 6th ed., Alyea and Dutton, p. 28

EQUIPMENT 3–squeaky–clean 500 mL round–bottom flasks, with rubber stoppers (detergent + 3 washes with distilled water + concentrated nitric acid + 4 washes with distilled water). Store with flasks full of distilled water.
4–10 mL graduated cylinders

CHEMICALS **A** = 5.0 g honey in 50 mL distilled water. Add 0.6 g tartaric acid, boil, cool and add 10 mL ethanol to stabilize. Dilute to 100 mL.
B = 4.0 g silver nitrate/50 mL
C = 6.0 g ammonium nitrate/50 mL
D = 10.0 g sodium hydroxide/100 mL

PROCEDURE Into a flask pour 10 mL **A.** Mix 5 mL **B** and 5 mL **C** and add to flask. Quickly pour in 10 mL **D,** stopper and vigorously shake. [IMPORTANT: After a few minutes, pour the flask contents down the sink and wash out the flask to prevent an explosive mixture from forming.]

***What is Happening*:**

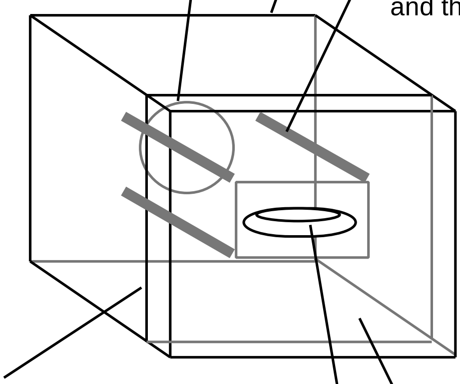
The silver present initially reacts with NH_3 to form $Ag(NH_3)_2^?$. The dextrose, a sugar present in honey, gently causes the silver ions present to be reduced to pure silver metal. (If the reaction was too quick, the silver would be formed as a precipitate in the solution, not on the walls of the flask.)

SMOKE CANNON

CODE NAME Ammonia–Hydrochloric acid smoke **DEMO #** Gen.13

REFERENCE Seen at the B.C. Museum of Science and Technology

EQUIPMENT
- Smoke cannon, made as follows



- support for smoke cannon, such as a chair with a rotating bottom or an inverted wastepaper bucket
- paper towel

CHEMICALS Concentrated hydrochloric acid (in squirt bottle)
Concentrated ammonia (in squirt bottle)

PROCEDURE Invert the chair or other support at the end of a bench on one side of the room, put cannon in feet of chair to make a rotating gun mount or place cannon on top of waste basket. Place some ammonia and hydrochloric acid at different places on a paper towel inside the cannon. Pull back handle on plastic sheet and fire.

What is Happening

Ammonia and hydrochloric acid give off fumes which combine to form a "smoke" made of solid ammonium chloride. As the air rushes out of the mouth of the cannon, a region of partial vacuum forms in the region behind the onward–rushing air. This partial vacuum pulls in the surrounding air and forms a doughnut–like "vortex" which is similar to a miniature "tornado".

INSTANT FIRE

CODE NAME Rapid oxidation of zinc **DEMO #** Gen.14

REFERENCE Chemical Curiosities: Spectacular Experiments and Inspired Quotes, p. 45

EQUIPMENT
pile of ceramic pads
dustpan and brush
squeeze bottle of water or water squirt pisol
2 spatulas

CHEMICALS
vial containing 4.0 g powdered zinc
vial containing 4.0 g NH_4NO_3 + 1.0 g NH_4Cl + 0.5 g $Ba(NO_3)_2$

PROCEDURE Pour contents of one of each type of the 2 vials onto middle of ceramic pad. Mix very carefully with spatula. At arms length, squeeze a few drops of water on the mixture. Care: flares up quickly!

What is Happening:

Powdered zinc has an enormous surface area. When water is added, the zinc is ionized and creates a substantial amount of heat in the process. The ammonium nitrate is a strong oxidizing agent which accelerates the reaction and eventually causes the zinc to burn in air.

DRY HANDS IN WET WATER

CODE NAME Hydrophobic powder **DEMO #** Gen.15

REFERENCE

EQUIPMENT 2 L beaker
jug of water

CHEMICALS 10 g of lycopodium powder

PROCEDURE Pour test tube of lycopodium powder onto the surface of the beaker of water. Slowly push hand below the surface of the water and then bring your hand back out. The hand will be dry.

What is Happening:

Lycopodium powder is "hydrophobic" (it repels water, similar to oil). When a hand is pushed down into the water, a thin layer of air is trapped between the hand and the powder. Since the powder repels water, the hand remains dry. The beautiful silvery colour of the water against the hand is actually the reflection of light off the water–air interface. (This might be similar to how a fish sees the sky.)

THE BLACK WITCH EATS THE GREAT PUMPKIN

CODE NAME Old Nassau clock reaction **DEMO #** Gen.16

REFERENCE Chem 13 News, November 1976, p. 9

EQUIPMENT 4–25 mL graduated cylinders (labelled A, B, C)
6–250 mL beakers

CHEMICALS **A** = 15.0 g potassium iodate / L
B = 0.78 g mercuric nitrate / 2L
C = Make a paste of 4.0 g of soluble starch in a small amount of water and add to 900 mL of boiling water. Boil for a few minutes, cool, and then add 15.0 g sodium metabisulphite, 1.0 g salicylic acid and 10.0 mL ethanol. Finally, bring the volume to 1 L.

PROCEDURE Add 20 mL **A** to 115 mL **B** and then add 20 mL **C**, stirring well for 15 seconds

What is Happening:

A reaction quickly produces orange–coloured mercury(II) iodide, but a second reaction starts to use up the mercury(II) iodide and produce iodine molecules. A third reaction is using up the iodine molecules as fast as they are made, but when the third reactant is finally used up the iodine being produced is available to react with a starch–salicylic acid mixture to produce a black colour.

DISAPPEARING WATER

CODE NAME Sodium polyacrylate gel **DEMO #** Gen.17

REFERENCE commonly known

EQUIPMENT Part A: small glass (with even lip)
piece of cardboard

Part B: styrofoam cup, piece of cardboard having "Do not remove this cardboard" written on both sides
Water pitcher

CHEMICALS jug of water
sodium polyacrylate powder

PROCEDURE Part A: Fill the glass 3/4 full of water, place the cardboard over the end of the glass and invert the glass. Let go of the cardboard and the water stays in the glass.

Part B: Put some sodium polyacrylate powder into a styrofoam cup (ahead of time, unseen). Have a student hold the cup in the air with both hands. Then pour water out of the pitcher into the cup and put the second piece of cardboard over the mouth of the cup. While the student is still holding the cup, turn it upside down over the student's head and lower the cup onto the student's head. Then, pull the piece of cardboard out and have the student read the card. Finally, lift the cup up off the student's head, showing that no water comes out.

***What is Happening*:**

Part A: As the water tries to come down out of the glass, the pressure inside the cup is lowered. The greater pressure of the atmosphere outside then pushes the cardboard firmly against the rim of the glass.

Part B: The sodium polyacrylamide quickly forms a gel when water is added.

METHANE BUBBLES

CODE NAME Combustion of methane bubbles **DEMO #** Gen.18

REFERENCE Chemical Demonstrations: A Handbook for Teachers of Chemistry, Vol 1, p. 113

EQUIPMENT
3 foot length of rubber tubing
thistle tube or small glass funnel to fit tubing
meter stick
candle
tape (tape candle to end of meter stick)
matches
250 mL beaker to hold bubble solution.

CHEMICALS To about 50 mL of bubble solution add about 10 mL of glycerine and 1 mL of corn syrup. Stir, stopper and store until needed.

PROCEDURE Light candle, turn on natural gas (with tubing and thistle tube or funnel attached. Put end of thistle tube in bubble solution, blow a bubble and ignite bubble with candle.

***What is Happening*:**

When the methane forms a bubble in the soap solution, the resulting bubble is slightly heavier than air (propane has a molar mass of 44, compared to an average molecular mass of 29 for air). Since the interior of the bubble is pure propane, the flame ignites the outside of the bubble and burns toward the inside. This happens so slowly that the heat generated spreads out the remaining gas and causes a “fireball” to form.

SELF–INFLATING BALLOON

CODE NAME Sublimation of CO_2 in a balloon **DEMO #** Gen.19

REFERENCE idea inspired by A Demo A Day, Volume 2: Another Year of Chemical Demonstrations, p. 148

EQUIPMENT
balloons
dewar flask
mortar and pestle
gloves
scoopula

CHEMICALS dry ice

PROCEDURE Fill a balloon with crushed dry ice (scoopula may help). When balloon is full, tie the balloon closed and let it warm up.

What is Happening:

Solid dry ice (carbon dioxide) has a very small volume but when it sublimes at –78^{o}C the resulting gas has a molar volume of 22.4 L for every 44 g (one dry ice puck has a mass of about 50 g).

FIREFLIES

CODE NAME Catalytic oxidation of ammonia **DEMO #** Gen.20

REFERENCE Journal of Chemical Education, vol. 77, Feb. 2000, p. 177

EQUIPMENT 5 or 10 L flask with stopper to fit or piece of aluminum foil to act as a cap
deflagrating spoon
bunsen burner and flint striker

CHEMICALS A deflagrating spoonful of CrO_3 (**CAUTION:** known carcinogen. Produce CrO_3 by placing a small
piece of magnesium ribbon in about 20 g of ammonium dichromate, piled on several ceramic fibre pads in an operating fume hood. Ignite the magnesium wick with a bunsen burner. The resulting “ammonium dichromate volcano” produces a voluminous amount of green CrO_3.)
10 mL of concentrated ammonia

PROCEDURE Pour 10 mL of concentrated ammonia into a large flask, stopper and swirl to fill the inside of the flask with ammonia gas. Heat a deflagrating spoonful of CrO_3 with a bunsen burner until the green powder glows red–hot. Quickly remove the stopper from the flask and tap the heated CrO_3 into the flask full of ammonia gas. As the powder floats down through the gas, the powder glows with incandescent heat and darts around in the flask like miniature “fireflies”.

MELTING STYROFOAM CUP

CODE NAME Dissolving styrofoam in acetone **DEMO #** Gen.21

REFERENCE Journal of Chemical Education, Vol. 53, Number 9, September 1976, p. 577

EQUIPMENT
2 – new styrofoam cups
2 – identical glass juice containers

CHEMICALS
250 mL of acetone
250 mL clean drinking water

PROCEDURE One juice bottle contains drinking water and has an identifying mark; the other contains acetone and has a different identifying mark.

Pour distilled water into cup and drink. Ask if someone else wants a “nice strong drink” and quickly pour half a cupful of acetone (HOLD IT OVER AN ORANGE BUCKET OR A SINK WHEN OFFERING IT TO SOMEONE – you have 3 seconds before the bottom drops out!)

OSCILLATING REACTION : YELLOW AND BLUE

CODE NAME Oscillating reaction involving malonic acid and KIO_3 **DEMO #** Gen.22

REFERENCE Chemical Demonstrations: A Handbook for Teachers of Chemistry. Volume 2, p. 248

EQUIPMENT
Magnetic stirrer and stir bar
600 mL beaker
3–100 mL graduated cylinders

CHEMICALS
Solution **A** = 205 mL of 30% hydrogen peroxide diluted to 500 mL
Solution **B** = 21.5 g potassium iodate is added to 400 mL of distilled water. Then add 2.2 mL concentrated sulphuric acid, and stir until all solid is dissolved and dilute to 500 mL.
Solution **C** = Dissolve 8.0 g of malonic acid and 1.7 g of manganese sulphate monohydrate in about 300 mL of water. Make a paste of 0.15 g soluble starch in 5 mL of water and add, with stirring, to 50 mL of boiling water. Boil for a few minutes, then add the starch solution to the malonic acid/manganese sulphate solution. Dilute to 500 mL.

PROCEDURE Put 100 mL of solution **A** in 600 mL beaker and sit on magnetic stirrer at lowest setting. Then add 100 mL of solution **B** and then 100 mL of solution **C.**

After a short while, the mixture oscillates between a yellow colour and a blue colour.

A COLOURFUL TORNADO

CODE NAME Universal indicator colours with magnetic stirrer **DEMO #** Gen.23

REFERENCE commonly known

EQUIPMENT Magnetic stirrer with stirring bar
2 L beaker

CHEMICALS dropper bottle of universal indicator solution
large dropper bottle of 0.1 M HCl
large dropper bottle of 0.1 M NaOH

PROCEDURE Fill the beaker about 7/8 full of tap water, add about 10-15 drops of universal indicator to the water. Turn on the magnetic stirrer and SLOWLY increase the stirring rate until the "tornado" is about 3/4 of the way to the bottom. Adding acid to the water changes the colour to yellow, then orange and finally red. Adding base to the water reverses the sequence of colours and then goes from green to blue to purple.

***What is Happening*:**

A universal indicator is a combination of indicator dyes, such as litmus, each of which changes to a different colour at a different acidity level. The acid and base added to the solution provide the necessary change in acidity.

THE DISAPPEARING GLASS ROD

CODE NAME Refractive index of pyrex glass in baby oil **DEMO #** Gen**.**24

REFERENCE Jim Hebden was shown this by a student

EQUIPMENT Piece of pyrex rod
100 mL graduated cylinder

CHEMICALS 100 mL of baby oil

PROCEDURE Fill the 100 mL graduated cylinder with baby oil**.** Insert a long pyrex glass rod into the cylinder**:** the portion of the glass immersed in the baby oil seems to disappear**.**

What is Happening:

Baby oil and pyrex glass have the same refractive index (ability to bend light as it passes through)**.** We can see a clear and colourless glass tube because light refracts (bends) as it passes through the glass and also reflects off the glass**.** Since the glass is in a fluid that refracts light identically to the way light refracts in glass**,** no refractive difference is seen to "cue" us visually**,** and since all the light passes unhindered through the combined glass and fluid**,** no reflection off the glass is seen**.**

GROWING SILVER CRYSTALS UNDER A MICROSCOPE

CODE NAME Observing silver crystal growth **DEMO #** Gen.25

REFERENCE Chem 13 News, November 1976, p. 18

EQUIPMENT Stereomicroscope, with glass slide and light source

CHEMICALS Dropper with a few millilitres of 0.1 M silver nitrate
Piece of sanded medium gauge copper wire, 1/4 inch long

PROCEDURE Place a slide on the microscope platform and put a piece of copper wire in the middle of the slide. Adjust the scope to focus on the wire. Add a single drop of silver nitrate onto the wire. Watch the crystals of pure silver metal grow!

***What is Happening*:**

This is a single replacement reaction between silver ions and copper metal

$$2\ AgNO_3(aq) + Cu(s) \ \ ? \ \ 2\ Ag(s) + Cu(NO_3)_2(aq)$$

The silver metal grows as fern-like crystals on the copper wire and the solutions slows turns blue due to the Cu^{2+} produced.

SLIME

CODE NAME Polyvinyl alcohol–borax gel **DEMO #** Gen.26

REFERENCE Chemical Demonstrations: A Sourcebook for Teachers, Volume 2, p. **97**

EQUIPMENT
100 mL graduated cylinder
10 mL graduated cylinder
scoopula
250 mL beaker

CHEMICALS
A = 5 L of 4% poly(vinyl) alcohol (40.0 g/L of hot water. Heat to a maximum of 70^{o}C; do not boil. Use magnetic stirrer overnight to dissolve)
B = 1 L 4% borax solution (40.0 g sodium tetraborate decahydrate diluted to 1 L)
Food colouring

PROCEDURE Measure 50 mL of poly(vinyl) alcohol into 100 mL graduated cylinder and pour it into a 250 mL beaker. Pour 8 mL of borax solution into a graduated cylinder. Add 2 drops of your favourite food colour to the graduated cylinder. Slowly pour the borax solution into the beaker while continually stirring with a metal spatula. Scoop the material out of the beaker with your hands and knead it into a ball. You have just made “Slime”.

ORANGE JUICE CLOCK

CODE NAME Magnesium–orange juice battery **DEMO #** Gen.27

REFERENCE Journal of Chemical Education, Vol. 73, Number 12, December 1996, p. 1123

EQUIPMENT Wall clock (with battery removed)
stand to support clock
400 mL beaker

CHEMICALS One can of orange juice, diluted as per label directions
30 cm strip of lightly sanded magnesium ribbon
30 cm piece of lightly sanded medium gauge copper wire

PROCEDURE Connect the strips of magnesium to the battery clips in the clock, so that the magnesium strips hang well below the clock. Coil the bottom of the strips around a pencil. When ready to operate, lower the magnesium strips into the orange juice.

What is happening:

Hydrogen gas and magnesium ions are formed in a chemical reaction which gives off sufficient energy (in the form of electricity) to be able to power the clock. The clock will run for a few days on this solution.

THE SELF–LIGHTING CANDLE

CODE NAME Oxidation of sugar–chlorate mixture **DEMO #** Gen.28

REFERENCE Chemical Demonstrations: A Sourcebook for Teachers, Volume 2, p. 107

EQUIPMENT candle with holder
stirring rod

CHEMICALS very small bottle of concentrated sulphuric acid
GENTLY mix a pea-sized amount of potassium chlorate with an equal amount of sugar.
DANGER: NEVER GRIND ANYTHING WITH POTASSIUM CHLORATE. IT IS A POWERFUL OXIDIZING AGENT AND MAY EXPLODE. GENTLY MIX THE SUGAR AND POTASSIUM CHLORATE BY PLACING THEM IN THE MIDDLE OF A SHEET OF PAPER AND ROCKING THEM BACK AND FORTH.

PROCEDURE Make a 1/4 inch depression in the top of the candle, next to the wick and gently fill the depression with the sugar/potassium chlorate mixture. Carefully touch the top of the mixture at the top of the candle with a long stirring rod having a drop of sulphuric acid on the top. In a few seconds the flame will be produced and the candle will appear to light.

SIMULTANEOUS MULTI–COLOURED CLOCK REACTIONS

CODE NAME Simultaneous clock reactions **DEMO #** Gen.29

REFERENCE

EQUIPMENT
2 - 400 mL beakers
2–600 mL beakers
4 - glass stirring rods

CHEMICALS
100 mL of 1% starch solution (Make a paste of 1 g of soluble starch in a few millilitres of water and add, with stirring, to 80 mL of boiling water. Boil for a few minutes, cool and dilute to a total of 100mL.)
2 –vials containing 0.983 g of potassium iodate, KIO_3 .
2–vials containing 1.189 g of sodium metabisulphite, $Na_2S_2O_5$

PROCEDURE
Dump one vial of KIO_3 into each of TWO 400 mL beakers containing 250 mL of water and stir until dissolved.
Dump one vial of $Na_2S_2O_5$ into each of TWO 600 mL beakers containing 150 mL of water and stir until dissolved.
Into ONE of the 400 mL beakers pour 1 mL of starch solution.
Simultaneously, pour the solutions in the 400 mL beakers into the 600 mL beakers.

One beaker abruptly produces a red solution, and the other produces a blue one.

ELEPHANT'S TOOTHPASTE

CODE NAME Reduction of hydrogen peroxide by iodide **DEMO #** Gen.30

REFERENCE Chem 13 News, May 1997, p. 8

EQUIPMENT 500 mL graduated cylinder
gloves
sponge for clean up

CHEMICALS 200 mL of 30% hydrogen peroxide
15 mL of dish washing detergent
10 g of potassium iodide

PROCEDURE Pour about 200 mL of hydrogen peroxide into the graduated cylinder, add about 15 mL of detergent and add about 10 g of sodium iodide. Huge yellow worm springs out of cylinder!

***What is happening*:**

The hydrogen peroxide oxidizes the iodide ion to iodine, while simultaneously releasing oxygen gas. The gas is trapped in the detergent, creating a foam.

CALCIUM CARBIDE IN A BALLOON

CODE NAME Acetylene explosion **DEMO #** Gen.31

REFERENCE Chemical Demonstrations: A Sourcebook for Teachers, Volume 1, p. 16

EQUIPMENT
Balloon
500 mL filtration flask
rubber stopper for flask
oxygen tank
candle attached to meter stick
matches

CHEMICALS
calcium carbide
water

PROCEDURE Put several pellets of calcium carbide into flask, fill flask with oxygen and stopper, warp balloon around side arm of flask. Add water to flask and quickly re–stopper, letting acetylene fill balloon. Tie off balloon and put in fume hood. Light candle and carefully touch to balloon. Ka–Bang!

What is happening:

Acetylene, produced from the reaction of water and calcium carbide, forms an explosive mixture with oxygen.

FLOATING BUBBLES IN CO_2

CODE NAME Density of CO_2 vs air
DEMO # Gen.32

REFERENCE A Demonstration–A–Day...For High School Chemistry, p. 23

EQUIPMENT Battery jar

CHEMICALS sodium hydrogen carbonate (baking soda)
vinegar or other dilute acid
bubble solution and bubble wand

PROCEDURE Fill the battery jar with carbon dioxide by reacting baking soda with acid (or using a chunk of dry ice or using a tank of carbon dioxide). Blow a bubble into the battery jar.

The bubble will float, almost motionless, on the dense layer of carbon dioxide. If the bubble persists long enough, the bubble will grow as carbon dioxide diffuses into the bubble.

RIPPLE TANK FIREBALL

CODE NAME Combustion of methane bubbles **DEMO #** Gen.33

REFERENCE A Demonstration–A–Day...For High School Chemistry, p. 24

EQUIPMENT
Ripple tank (used in physics)
Metre stick
candle
match
rubber tubing to go from natural gas outlet to ripple tank

CHEMICALS
Joy dishwashing detergent
water to fill ripple tank
natural gas

PROCEDURE MIx sufficient dishwashing detergent into the water in the ripple tank to make good bubbles. Bubble natural gas (methane) through the tank to produce a good stack of bubbles, and then turn off the natural gas. Tape a candle to a metre stick and light the candle. Ignite the bubbles in the ripple tank to produce a fireball. Very dramatic and gives excellent pictures.

HYDROGEN IN A BOTTLE

CODE NAME Hydrogen–air explosion **DEMO #** Gen.34

REFERENCE A Demonstration–A–Day...For High School Chemistry, p. 28

EQUIPMENT
Large plastic milk or bleach bottle with bottom removed
Hydrogen generator (500 mL vacuum filtration flask, fitted with a #7 stopper)
Rubber tubing to lead hydrogen from generator to bottom of plastic bottle
One–hole rubber stopper to fit top of plastic bottle, the stopper should be fitted with 6 mm glass tubing that extends 3-4 cm above the top and just goes far enough into stopper to avoid falling out.
Stand and test tube clamp
Small stopper or aluminum foil cap to minimize loss of hydrogen from glass tubing
Match.

CHEMICALS Source of hydrogen gas (generate hydrogen with zinc and hydrochloric acid or aluminum and sodium hydroxide)

PROCEDURE Place the stopper/glass tube assembly into the top of the plastic bottle and clamp the bottle to the stand by the handle of the bottle, such that the open bottom faces down. Fill the bottle with hydrogen and remove the hydrogen generator far from the vicinity of the plastic bottle. Remove the small stopper/cap from the glass tube and ignite the gas coming out the top of the glass tube.

At first, the gas will burn with a blue flame, about one inch tall. As the hydrogen is burned, oxygen is drawn into the bottom of the bottle. In 2 to 5 minutes there is a brilliant flash and a THUMP as the hydrogen explodes. Since the hydrogen is not contained, the noise is not loud.

FLASH PAPER

CODE NAME Flash paper **DEMO #** Gen.35

REFERENCE

EQUIPMENT
tissue paper
tongs
paper towels
250 mL beaker
ice bath

CHEMICALS
70 mL of concentrated sulphuric acid
30 mL of concentrated nitric acid
250 mL of 1 M sodium hydrogen carbonate, $NaHCO_3$

PROCEDURE Place a 250 mL beaker in an ice bath and add 70 mL of concentrated sulphuric acid and 30 mL of concentrated nitric acid to the beaker. Cut the tissue paper into approximately 2 inch squares. Using tongs, immerse each piece of tissue paper in the acid mixture for about one minute. Next, rinse each piece of paper in three successive 500 mL water baths. Use fresh water for each piece of paper. Next immerse each piece of paper in 250 mL of 1 M $NaHCO_3$. If substantial bubbling occurs, re–rinse in water and neutralize in $NaHCO_3$ again. Spread on paper towel to dry overnight.

To demonstrate the burning of flash paper, light a candle or bunsen burner and throw the paper into the flame. The flash paper burns very quickly and leaves, at most, a tiny residue of white ash.

Large amounts of flash paper should not be stored for any length of time.

PAINT CAN EXPLOSION

CODE NAME Explosive methane mixture **DEMO** # Gen.36

REFERENCE A Demonstration–A–Day**...**For High School Chemistry, p. 52

EQUIPMENT Empty paint can (obtain from paint store)
rubber tubing to fill can with natural gas
tape
match
(Optional: 24 inch square of METAL screen door mesh)

CHEMICALS source of natural gas

PROCEDURE Drill a 1/4 inch hole in the centre of the lid of the paint can. Drill a similar hole in the side of the can, about one inch from the bottom.

Press the lid on firmly BUT NOT AS HARD AS YOU CAN, and fill the can with natural gas for one minute. Turn off the natural gas and place tape over each hole.

When ready to do the demonstration, remove the tape and light the gas coming out of the lid. CARE: keep your head clear of the top of the lid in case there is too much oxygen inside and the gas explodes prematurely. Initially, the flame will be from half an inch to two inches high. As the gas burns, oxygen is drawn in the side and when the mixture inside is about 15% methane an explosion occurs and blows the lid to the ceiling. Note: the flame gets down to about 1/4 inch high when the explosion is about to occur.

Optional: If the demonstration is repeated but with a 24 inch square of metal mesh wadded up so that it fills the inside of the can but dopes not quite touch the lid, an explosion DOES NOT OCCUR. This is the principle of the miner's safety lamp, invented by Sir Humphrey Davies. The metal conducts the heat away from the gases sufficiently to keep the gases below their ignition temperature. (A very small "pop" may occur, but no explosion.)

THE METHYLENE BLUE TRAFFIC LIGHT

CODE NAME Oxidation of methylene blue **DEMO #** Gen.37

REFERENCE Tested Demonstrations in Chemistry, 6th ed., Alyea and Dutton, 1965, p. 187

EQUIPMENT 500 mL florence flask with stopper to fit

CHEMICALS
300 mL distilled water
8 g potassium hydroxide
10 g dextrose
6–8 drops of methylene blue indicator (indicator solution prepared by dissolving 0.20 g methylene blue in 100 mL water)

PROCEDURE Dissolve 8 g KOH in 300 mL distilled water in 500 mL florence flask. Just prior to doing the demonstration, dissolve 10 g dextrose in the KOH solution and then add 6–8 drops of methylene blue solution. Swirl the flask and allow it to sit undisturbed until it becomes colourless (about one minute).

To do the demonstration, give the flask a quick shake or two. The blue colour appears again and then slowly fades. This process can be repeated many times.

What is Happening:

The oxygen present in the flask oxidizes the methylene blue dye to its blue form. The basic conditions cause the dextrose to reduce the methylene blue dye to its colourless form. Shaking the flask reintroduces more oxygen into the solution and re-oxidizes the methylene blue to its blue form, continuing the cycle until the oxygen in the flask is used up.

GLOWING TONIC WATER

CODE NAME Fluoresence of quinine **DEMO #** Gen.38

REFERENCE Chem 13 News, April 1992, p. 5

EQUIPMENT UV light
large beaker or other large container with a wide mouth

CHEMICALS bottle of tonic water

PROCEDURE In a darkened room, pour the contents of a bottle of tonic water into a large beaker while shining a UV lighton the liquid. The tonic water will glow bright blue as a result of the fluoresence of the quinine present in solution.

MAGIC SAND

CODE NAME Hydrophobic liquid **DEMO #** Gen.39

REFERENCE Journal of Chemical Education, vol. 67, June 1990, p. 512

EQUIPMENT large plastic tote tray
sand

CHEMICALS spray can of ScotchGard™

PROCEDURE In a very well ventilated area, such as a fume hood, constantly stir some dry clean sand while spraying with ScotchGard until the sand is “wet” . About 110 g of ScotchGard is required for 250mL of sand. Let the sand dry overnight.

When dry, the sand takes on strange “intestine–like” structures when poured into a large beaker full of water. Reach in, grab a handful of the sand and bring it to the surface — it remains dry!

What is happening: ScotchGard contains a chemical that repels water. When the “carrier” solvent dries, the water-repelling (hydrophobic) chemical remains, coating the sand and causing the sand to become hydrophobic.

SALT WATER OSCILLATOR

CODE NAME Salt water oscillator
DEMO # Gen.40

REFERENCE Journal of Chemical Education, vol. 66, March 1989, p. 205

EQUIPMENT 60 mL plastic syringe, with cap for tip
large beaker (1 or 2 L)

CHEMICALS 100-200 mL of saturated sodium chloride solution
methylene blue dye (or any other highly coloured dye)

PROCEDURE Remove the plunger from the syringe and fill the barrel with saturated NaCl(aq) to which has been added sufficient dye to give a reasonably intense coloration. Place the tip of the syringe in a large beaker which is 3/4 full of water, such that the level of the solution in the syringe is about level with the surface of the water inside the beaker. Remove the syringe cap. The salt solution will alternately flow out of the syringe, then stop flowing and allow pure water to flow up into the syringe. The inward flow then stops and the salt solution again flows out of the syringe. This cycle repeats itself several times. Try varying the relative levels of the salt solution and surrounding water by raising and lowering the syringe in the beaker.

The Journal article discusses the complex theory behind the oscillation.