Chemistry at Work – a guide for presenters (Northern Ireland, secondary)

Thank you (and your organisation) for agreeing to give a presentation at the forthcoming Chemistry at Work event at XXXXX on DDDDDD, which is for students aged FFFF.

The Chemistry at Work programme is sponsored by the Royal Society of Chemistry and has been running since 1991. There will be about 40 events this year across the UK.

More general information about Chemistry at Work can be found at http://www.rsc.org/lap/educatio/chemwork.htm. For information about this particular event, please contact the Local Organiser, XXXX, on YYYYY.

These notes are aimed to help you give the best possible presentation to your audience of young people.

Aims

The aims of Chemistry at Work are:

- To present a positive image of chemistry and the chemical sciences to young people at school or in college
- To show the variety of what chemists do and how chemistry is part of some jobs where it may not have been expected
- To show that chemistry is an important part of the economy of the country
- To show that chemistry is an interesting and exciting way to earn a living
- To show that chemists are real people (and not nerds).

The events are *not* primarily careers events (although if students leave the event favourably disposed towards a career in chemistry this would be a bonus). Neither are they primarily aimed at teaching students chemistry (although if they leave the event with some extra knowledge, this, too, is a bonus).

What is a Chemistry at Work event like?

Every Chemistry at Work event is different in detail and has its own character. The following points describe a typical event.

- It is aimed at young people at school (different events cater for different age groups from primary to post-16)
- It takes place at a venue such as a school, college, university, conference centre, industrial workplace, *etc*
- It lasts from 1 to 3 days
- It takes the form of a ‘circus’ of several (typically six to eight) short (approximately 25 minute) presentations in which presenters explain how they use chemistry in their everyday work. This may then lead to a related practical activity that is linked (in some way) to their work
- Ideally presentations are interactive and ‘hands on’ as much as possible
- Small groups of students (15 to 20) move around the presentations accompanied by a teacher
- Each student will spend half a day at the event and experience about six presentations
- Some events finish with a talk / demonstration to all, often with a ‘wow’ factor
- It is visited by up to 300 students per day.

Preparing your presentation

Outline

Your presentation will be about 25 minutes long. A presentation for young people needs to be different in many respects from one aimed at adults:

- You will need to grab the audience's attention – the students may not be at your presentation by choice
- You will need to break up your presentation – children have shorter attention spans than adults
- You will need to be aware of the chemistry that your audience does and does not know
- Your presentation will need to be interactive and 'hands on' wherever possible
- You will need to take care with technical terms, jargon and long words.

It will not be possible to cover a lot of detail in the time available, so choose three or four points that you would like to get across. Break up your talk by giving the audience things to look at, pass round or do. Vary your tone of voice. If possible have two (or more) presenters (ideally of different genders and/or ethnicities) to give the audience a different person to look at and a different voice to hear.

Content

Remember that you are not primarily trying to teach chemistry or sell chemistry as a career (at least directly). Your brief is to tell the students about how you use chemistry in your work, how your work fits in with everyday life and why you find your work interesting and stimulating. If at all possible, try to include something active for the students to do. Some simple practical work may be possible even if the event is not held in a laboratory.

Health and safety

The Local Organiser is responsible for general H&S issues such as what to do in the event of an emergency, but do make sure that you are aware of these too. The Local Organiser may not be a chemist and cannot be responsible for any issues to do with any demonstration you might do. You may be asked to fill in a simple risk assessment form. If you have any queries about this, contact the Organiser who can get advice from the National Coordinators.

Know your audience

It is important that you bear in mind the chemistry that your audience will know (and not know) when preparing your presentation. The best way to do this is to use the Northern Ireland Curriculum (see Appendix) – this is defined in terms of four Key Stages which cover the 12 compulsory school years. The Key Stages are as follows:

KS	School year group	Age
1	1-4	4-8
2	5-7	8-11
3	8-10	11-14
4	11-12	14-16
A level	12+ ('6th form')	16+

One can be confident that students in a particular Key Stage will be working on the material in that Key Stage and will have covered the material in earlier Key Stages.

Presentation software

Powerpoint™ and similar presentation software is excellent but beware of basing your whole presentation around it. If all the presenters use it, it can lead to a rather dull experience for the students. *You* are the resource they have come to see and hear!

If using Powerpoint™, structure your presentation so that it asks questions.

Also make sure that equipment is available at the venue if you are not bringing your own.

Tips for talking to teenagers

1. Children are not small adults

- Students may not be at your talk by choice – most adult audiences are (at some level!)
- Students will not share your vocabulary – both general language and technical
- Students will generally have shorter attention spans than adults
- Students will often lack the confidence to interact with the speaker – ask questions, interrupt *etc*, but may have the confidence to interact with their peers, possibly to the detriment of your presentation.

2. Say where you are going

Pick a small number of points (say three) that you want to get across

- Say what they are going to be
- Develop them
- Recap what they are - 'Tell 'em what you're going to tell 'em, tell 'em, then tell 'em what you've just told 'em.'

3. Be varied

- Children are used to regular changes of activity rather than concentrating on one long argument – look at a children's magazine or TV programme if you are not convinced
- Give the audience things to do, hear, see, (even feel or smell, if appropriate)
- If possible have more than one presenter to vary tone of voice and delivery (better still if the presenters are of different genders and / or ethnicities)
- Involve the audience – get them to help with demonstrations
- Ask questions - but be prepared to wait for answers (at least 30 seconds) and don't be thrown if you get no answer at all or one that you don't expect.

4. Things to avoid

- Jargon – this could be
    * technical terms ('new chemical entity', 'anion')
    * phrases – 'increase in pH' is confusing as it sounds like 'more acidic'; why not say 'more alkaline'?
    * passive language ('it can be shown that')
- Being derogatory (by implication) about their attainments *eg* 'I did differential equations at O-level'
    * You probably didn't
    * There will be plenty of things they can do that you couldn't at their age (such as surfing the internet)

- Aping ‘yoof’ culture – don’t talk about the latest pop group, trends, fashions *etc* unless you are very sure of your ground ‘daddy-oh’
- Sexism and racism – these are almost always implicit rather than deliberate, but what message does it give if the presenter is always white and male and his assistant female and / or non-white?
- Being threatening – don’t imply the audience is stupid if they can’t or won’t answer questions. At the very least they need time to answer.

5. Do

- Introduce yourself, your organisation and your place in it. ‘I’m Anne Smith and I work for ------ which makes ------. I make sure that all the ------ are ------‘.
- Take ‘goodies’ to give away – company pens, posters *etc etc*
- Visit the venue beforehand. Is there an OHP, projection screen, data projector, blackout etc?
- Praise answers to questions even if they are not the ones you expected / hoped for
- Use analogies to explain difficult ideas – for example 1 part per million is the same as a £5 note hidden in a pile of paper 50 m high (about the height of a 15 storey building), one Pascal is a pressure roughly equivalent to the weight of an apple spread over an unfolded newspaper
- If possible, talk to the teacher or organiser beforehand to find out about the groups and their backgrounds, particularly any groups with special needs
- Time your talk so it fits the slot.

6. Watch out for

- Units – most children will not be familiar with non-metric units – inches, pounds *etc*
- Chemical names: systematic names are generally used in schools – post-16 students will not know what acetaldehyde is but they will know the name ethanal
- Chemical notation – skeletal formulae and shorthand such as a hexagon for cyclohexane will mean nothing to pre-16 students
- Make sure that you and any audio visual aids are visible and audible – sit at the back beforehand – can you see your overhead projector transparencies or slides? It is most frustrating (and only too common) to hear speakers say ‘I know you can’t read this at the back but…’.

Appendix

The following pages are taken from the *Materials and their properties* (*ie* Chemistry) section of the Northern Ireland Curriculum.

You may find it useful to skim the appropriate section(s) for the age group at which your presentation is aimed to get a feel for the level at which these young people are working.

The whole of the Northern Ireland Curriculum can be found at www.ccea.org.uk.

SCIENCE KS1

1

Materials

Properties

Pupils should be given opportunities to:

a work with a range of everyday materials in a variety of activities, *for example, know, through playing with plasticine or dough, that it can be pushed, pulled, squashed, stretched, rolled or flattened;*

b sort a range of everyday objects into groups according to the materials from which they are made, *for example, sort objects into sets of metal, wood, paper and plastic;*

c explore the properties of materials including shape, colour, texture and behaviour, *for example, sort materials or objects and explore whether they stretch, bend, tear, pour, and whether they are magnetic or non-magnetic;*

d find out some everyday uses of materials, *for example, find out that furniture can be made from wood and jumpers can be made from wool;*

e investigate similarities and differences in materials and objects and sort them according to their properties, *for example, sort plastics into those which are transparent and those which are opaque or sort fabrics into those which absorb water and those which are waterproof.*

Change

Pupils should be given opportunities to:

a find out about the effect of heating and cooling some everyday substances, such as water, chocolate or butter, *for example, describe changes that occur to chocolate when it is heated or jelly when it is cooled;*

b investigate which everyday substances dissolve in water, *for example, find out that salt and sugar dissolve in water and rice and sand do not.*

Environment

Pupils should be given opportunities to:

a identify the range of litter in and around their own locality, *for example, discuss the type of litter around the school;*

b find out how human activities create a variety of waste products, *for example, match waste*

products to the activity that created them;
c find out that some materials decay naturally while others do not, *for example, find out that fruit and leaves decay while aluminium cans and glass do not.*

SCIENCE KS2

2

Materials

Properties

Pupils should be given opportunities to:
a investigate similarities and differences in materials and objects and sort them according to their properties, *for example, sort plastics into those which are transparent and those which are opaque or sort fabrics into those which absorb water and those which are waterproof;*
b find out about the origins of materials and learn that some are natural and others are manufactured, *for example, find out that wood is natural and plastic is manufactured;*
c investigate the properties of materials and how these relate to their uses, *for example, investigate the strength of paper, or describe the different materials used in building a house;*
d investigate the distinctive properties of solids, liquids and gases as exemplified by water, *for example, learn that solids have a definite shape and volume, that liquids have a definite volume but take the shape of containers and that gas will occupy the space available.*

Change

Pupils should be given opportunities to:
a investigate which everyday substances dissolve in water, *for example, find out that salt and sugar dissolve in water and rice and sand do not;*
b know that when materials are changed this may be desirable or undesirable, *for example, find out that the change brought about by baking is desirable whereas the change brought about by rusting is undesirable;*
c investigate the changes of state brought about by heating and cooling everyday substances, *for example, investigate the effect of heat on ice and water and the reverse process;*
d relate changes of state to the water cycle;
e understand that when new materials are formed, change is permanent, *for example, learn that plastics are made from oil, paper is made from wood and that these changes are permanent;*
f investigate how rusting can be controlled, *for example, observe that the use of paints and oils (grease) will prevent rusting and protect iron.*

Environment

a find out how human activities create a variety of waste products, *for example, match waste products to the activity that created them;*
b find out that some materials decay naturally while others do not, *for example, find out that fruit and leaves decay while aluminium cans and glass do not;*
c understand that some waste materials can be recycled and that this can be of benefit to the environment, *for example, discuss the recycling of bottles, cans and paper.*

3

MATERIALS AND THEIR USES
Properties and Uses

Pupils should have opportunities to:

a understand the physical properties of gases and relate these to everyday uses, *for example, gases are often stored under pressure because they can be compressed;*

b prepare and identify common gases, including carbon dioxide, hydrogen, nitrogen and oxygen;

c investigate everyday materials, both natural and man-made, in terms of their physical properties, *for example, lustre, strength, hardness, elasticity, solubility in water, melting and boiling point, electrical and thermal conductivity, and density;*

d relate the uses of everyday materials to their physical properties, *for example, use of aluminium in aircraft manufacture because of its strength and density, diamond in cutting tools because of its hardness, and copper for making electrical cable because it conducts electricity;*

Classification

e understand classifications used in chemistry, including

• substances as solids, liquids and gases,

• solutions as acidic, alkaline or neutral, and the use of the pH scale in the classification of solutions,

• elements, compounds and mixtures, and to compare the physical and chemical properties of mixtures and compounds;

f be introduced to the Periodic Table and use it in investigations about physical and chemical properties of elements in terms of their position in the periodic table, including

• physical state, appearance, trends in melting points and boiling points,

• chemical properties of metals and non-metals;

g investigate techniques for separating and purifying mixtures, including

• the preparation of pure salt from rock salt,

• the separation of dyes in inks,

• recovery of the solvent from solutions using simple distillation;

Environment

h understand that some waste products can be recycled, including glass, paper and aluminium cans, and why this process is desirable;

i find out about the positive and negative effects of the exploitation of raw materials, *for example, the effect of quarrying on the local environment*

j find out about the methods used to monitor water purity, including the measurement of pH and the presence of soluble and insoluble materials;
k learn about the effects of corrosive gas pollutants, *for example, sulphur dioxide on building materials.*

Chemical Reactions

Pupils should have opportunities to:

Chemical Change

a investigate that when permanent changes occur new substances are formed and that these new substances have distinctive properties, *for example, compare the properties of magnesium with those of magnesium oxide;*
b investigate how rusting can be controlled;
c learn that useful products can be manufactured from various raw materials, *for example, the production of lime from limestone, glass from sand or plastics from oil;*
d investigate different types of chemical reaction, including:
• oxidation, *for example, burning magnesium and rusting,*
• reduction, *for example, removal of oxygen from copper oxide,*
• thermal decomposition, *for example, effect of heat on calcium carbonate or copper carbonate,*
• neutralisation, *for example, reaction of dilute hydrochloric acid and sodium hydroxide;*
e investigate the relative reactivity of metals based on their reactions with water, oxygen, dilute acids and the results of displacement reactions;
f understand the applications of chemical reactions in everyday contexts, including the extraction of iron in the Blast Furnace (details of process not required), the liming of soil in agriculture, indigestion (acid neutralisation);

Energy

g find out that some chemical reactions are exothermic while others are endothermic, *for example, that an increase in temperature occurs when water is added to calcium oxide;*
h be introduced to word equations and to represent chemical reactions using word equations.

Kinetic Theory

Pupils should have opportunities to:

Particles

a learn that all matter is made up of small particles;

States of Matter

b learn that heat changes ice to water and water to water vapour, and to relate these changes to the water cycle;
c understand the differences between solids, liquids and gases in terms of the proximity and motion of particles, including that
• ice cubes have a fixed shape as the particles are held together strongly,
• water can change shape because the particles are held less strongly and are able to move around,
• steam can spread around the room because the particles are separate and move rapidly;
d understand changes of state, diffusion and dissolving in terms of simple kinetic theory, including that heat is required to increase the movement and separation of particles and that heat must be supplied to vaporise liquids and melt solids;

Electronic Structure

e learn about the structure of atoms in terms of electrons, protons and neutrons, and to understand the structure of the first twenty elements of the Periodic Table.

4

MATERIALS AND THEIR USES

Properties and Uses

Pupils should have opportunities to:

a investigate the physical properties of gases and relate these to everyday uses, *for example, gases are often stored under pressure because they can be compressed;*

b prepare and identify common gases, including carbon dioxide, hydrogen, nitrogen and oxygen using their chemical properties;

c investigate everyday materials, both natural and man-made, in terms of their physical properties, *for example, lustre, strength, hardness, elasticity, solubility, melting and boiling point, electrical and thermal conductivity, and density;*

d relate the use of everyday materials to their physical properties, *for example, use of aluminium in aircraft manufacture because of its strength and density, diamond in cutting tools because of its hardness, and copper for making electrical cable because it conducts electricity;*

e investigate the properties of industrially important substances, *for example, metals, ceramics, glass, plastics and fibres,* and relate properties to simple models of their structures;

f learn about composite materials, illustrated by some common composite materials, *for example, reinforced concrete, glass-reinforced plastic and bone,* and make reasoned judgements about the choice of materials for particular uses;

Environment

g understand that some waste products can be recycled, including glass, paper and aluminium cans, and why this process is desirable;

h find out about the positive and negative effects of the exploitation of raw materials, *for example, the effect of quarrying on the local community;*

i find out about the methods used to monitor water purity, including the measurement of pH, oxygen content, soluble and insoluble materials;

j learn about the effects of corrosive gas pollutants, *for example, sulphur dioxide on building materials;*

k explain that pollution control is a national and international responsibility;

Classification

l understand classifications used in chemistry, including

• substances as solids, liquids and gases,

• solutions as acidic, alkaline or neutral, and the use of the pH scale in the classification of solutions,

• elements, compounds and mixtures, and to compare the physical and chemical properties of mixtures and compounds, *for example, differences in physical and chemical properties between iron (II) sulphide and a mixture of iron and sulphur;*
m be introduced to the Periodic Table and use it to investigate the physical and chemical properties of elements in terms of their position in the period table, *for example, to undertake a comparison of the properties of Group 1 and Group 7 elements, including physical state, appearance, trends in melting points and boiling points, and trends in reactivity of halogens with metals and hydrogen;*
n carry out a more detailed study of a range of metals and non-metals and their compounds, and investigate the different ways in which they can be classified as metallic, ionic, covalent molecular or giant covalent;
o understand simple trends in the properties of elements within groups and across periods of the Periodic Table;
p investigate techniques for separating and purifying mixtures, including
• the preparation of pure salt from rock salt,
• the separation of dyes in inks,
• the recovery of the solvent from solution using simple distillation.

Chemical Reactions

Pupils should have opportunities to:

Chemical Change

a investigate that when permanent changes occur new substances are formed and that these new substances have distinctive properties, *for example, compare the properties of magnesium with those of magnesium oxide;*
b investigate how rusting can be controlled;
c learn that useful products can be manufactured from various raw materials, *for example, the production of lime from limestone, glass from sand and plastics from oil;*
d investigate different types of chemical reaction, including
• oxidation, *for example, burning magnesium and rusting,*
• reduction, *for example, removal of oxygen from copper oxide,*
• chemical decomposition, *for example, effect of heat on calcium carbonate or copper carbonate,*
• neutralisation, *for example, reaction of dilute hydrochloric acid and sodium hydroxide;*
e relate important oxidation and reduction reactions and electrolytic decomposition to everyday examples and manufacturing processes;
f explain, in terms of ions, the causes and effects of water hardness, and outline methods of softening water, including boiling, addition of sodium carbonate and ion exchange;
g learn how chemicals are obtained from oil cracking;
h investigate quantitatively the different factors that effect the rates of chemical reactions and relate these factors to the practical problems associated with the manufacturing processes in industry
i find out that some chemical reactions are exothermic while others are endothermic, *for example, that an increase in temperature occurs when water is added to calcium oxide;*

Equations

j use symbolic equations qualitatively to describe chemical equations;

Electronic Structure and Chemical Formulae

k learn about the structure of atoms in terms of electrons, protons and neutrons, in order to understand the structure of the first twenty elements of the Periodic Table;
l learn about the formation of ions in terms of the addition or removal of electrons, and to work out the formula of simple ionic compounds, *for example, NaCl, MgO and* $CaCl_2$*.*

Kinetic Theory

Pupils should have opportunities to:

Particles

a investigate the Kinetic Theory as a model to explain changes of state and a range of other phenomena;
b explain the properties of typical ionic, covalent and metallic substances in terms of models

based on chemical bonding and use symbolic representation of these models in three dimensional form, diagrams and equations.