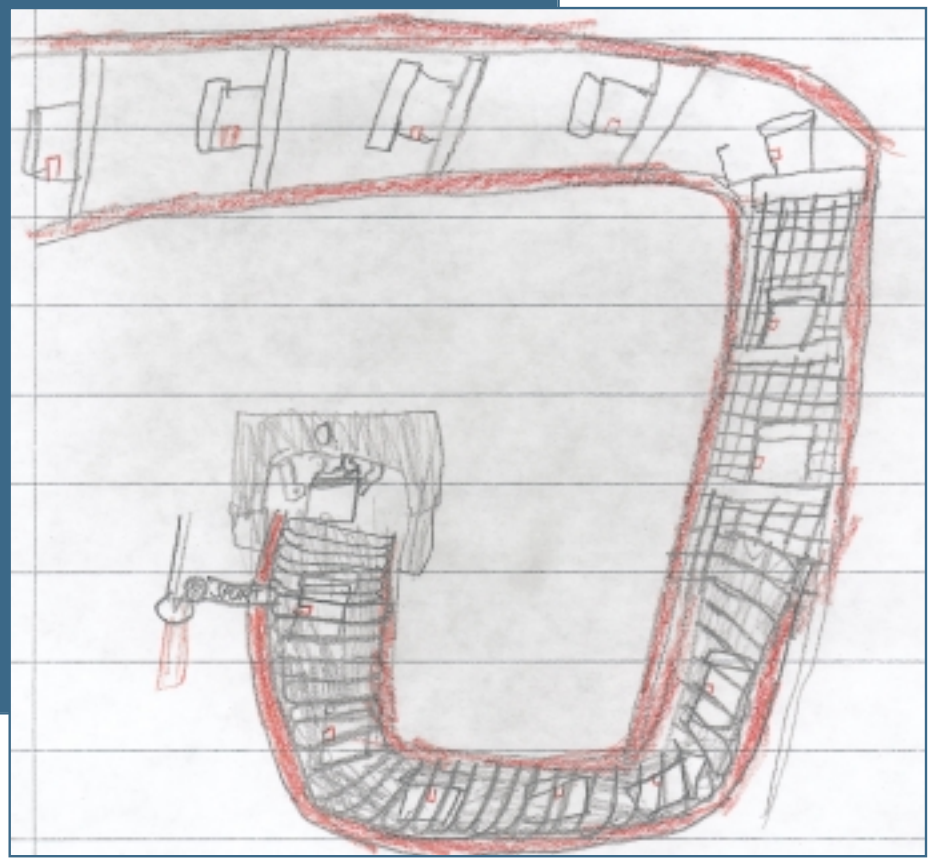
Educational site visits for schools

a CEFIC Education-Industry Partnership publication



A guide for companies

CEFIC
EUROPEAN CHEMICAL INDUSTRY COUNCIL

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Executive summary

Young people in Europe increasingly show a lack of interest in science. This is a source of concern for our industry because we depend upon well educated people in the sciences such as chemistry, physics, biology, mathematics and in chemical technologies. It is important, that we encourage young people, who will be the citizens and consumers of tomorrow's society, to gain a balanced view of science and the science-based industries.

The chemical industry has to show how it contributes to life today and in the future through offering opportunities and exciting challenges to young people. To do this the industry must consider an "open door" policy and invite the young to come in and examine how industry functions and indeed what it makes.

Young people appreciate the opportunity to see for themselves and question people working in industry directly. If the industry carefully plans these opportunities, young people will acquire up-to-date knowledge and positive attitudes towards the industry.

This publication seeks to provide you, the practising manager, with practical advice drawn from some excellent examples across Europe where companies and schools have worked together culminating in visits to a chemical site.

Research evidence shows that these kinds of contacts are good for the pupils and good for the companies involved. So be inspired and seize this moment to establish a company policy which welcomes visits from young people. Take time to invite your local schools to come and start an active visits programme with them.

The European Chemical Industry Council (CEFIC), strongly encourages you to see this activity as part of your Responsible Care commitment. Indeed in some countries, compiling the number of school site visits is being used as one performance indicator of the Responsible Care programme. It is the goal of the CEFIC's Education-Industry Partnership Working Party (EIP-WP) to have this accepted as a standard Responsible Care indicator.

The publication has been developed by CEFIC's EIP-WP as a pan-European project. The project was jointly led by Birgitta Resvik, Kemikontoret, Sweden and Miranda Stephenson, Chemical Industry Education Centre, the educational arm of the Chemical Industries Association, UK. The authors are two teachers, Brian Ratcliffe from the UK and Ulrica Westin from Sweden. The examples of good practice are taken from the Czech Republic, France, Sweden and the UK.

Introduction

Why go to the trouble of hosting school visits?

The chemical industry can derive much benefit from fruitful co-operation with neighbourhood schools. A popular, but not always successful way of co-operating, is the Site Visit. This document describes how to arrange successful site visits; it does this by illustrating a variety of good practice from several European countries using real case studies from pupils of different age groups.

- Do you find it difficult to attract the kind of staff you require?
- Do you wish to enhance your company image locally (or that of the chemical industry)?
- Do you want to contribute to improved public knowledge and understanding of science and industry?
- Do you want to find new ways to train and develop young employees?

If so, this document could help you.

- Does your company host visits from schools?
- Are you left with the feeling that such visits have been highly successful?

If so, then you will probably identify with much of the good practice described here. Hopefully, you will also find ways of extending and improving what you already do.

This document sets out the many benefits that flow from co-operation with schools, how to arrange successful site visits and illustrates a variety of good practice using case studies from different age groups and countries.

Research at the University of York by Joy Parvin(1) has shown that well-planned visits to chemical sites by young children dramatically improve their perceptions of the chemical industry.

Similar research studies have been carried out by Mary Beth Key(2) for visits by post-16 year old students which also show that a carefully planned visit can improve students' appreciation and understanding of the chemical industry.

The many benefits arising from site visits to the company by teachers and young people include :

- providing a context for learning in the classroom;
- contributing to an improved scientific and technological literacy in society;
- helping to inform young people of the career opportunities in the company;
- showing that the company is a responsible, caring organisation committed to the "Responsible Care" Programme;
- contributing to the creation of a balanced view of key issues, e.g. safety, health and environmental protection.

A carefully planned visit can improve students' appreciation and understanding of the chemical industry

Introduction

Background

The chemical industry is valued by only a small portion of the general public. In a European survey, overall opinion ranks the chemical industry second to bottom of eight manufacturing industries. Indeed, in Belgium, France and the UK the chemical industry currently obtains the lowest ranking - alas, a position they share with their colleagues in the United States and Australia. Changing this perception in the short term is difficult as opinions are frequently formed at a relatively early age and are difficult to change once formed. Studies at the University of York(1) have shown that well-planned and focused site visits have shown measurably improved perceptions from the visitors.

This change in perception is particularly dramatic where visits are made by those under 11 years. Such children are more open minded, receptive and questioning than older children. They are also more easily enthused and excited! Joy Parvin(1) has used questionnaires and interviews with children age 9-11 years before and after visits. Her research prior to visits has revealed the beginnings of prejudice by the children. Many believe that factories are “dirty and smelly”, “chemicals are dangerous” and the “best jobs are in offices” or as “the boss”. Following a visit the same children were found to have much improved perceptions. In the words of one child, “I want to be a scientist. It’s fun. You can invent things and not do the same job everyday.”

Jean Ruddock(3) of Cambridge University has written much about studies involving listening to children. Above 12 years of age, children start to form opinions and become less receptive and questioning. It is also “uncool” to show interest and be engaged in schoolwork. Although it is more difficult to change opinions once formed, site visits do have a measurable effect. The case study for this age group demonstrates how children became more engaged in their studies when they saw how work in school related to the real world. Children of 13-15 years are beginning to think beyond school and towards their future. They are often concerned about environmental issues and these contribute to their negative perspectives of industry. Addressing such issues and demonstrating the value of work in the chemical industry to their own well-being and to society often does lead to improved perceptions.

“I want to be a scientist. It’s fun.”

"Homework is uncool..."

Introduction

By the time they reach 16-18 years of age, a good proportion of young people has reached a decision about the kind of work they hope to do. Some still have not made up their minds. A good site visit will encourage some to think seriously about work in industry. It is also an opportunity to portray a more positive image of the chemical industry through discussions. The case study demonstrates the considerable enrichment to the study of chemistry for this age group.

In general, young people who have had a positive experience on one or more visits will view chemical companies more favourably. As adults, they will be better informed and thus able to make balanced judgements if, for example, they become involved in planning applications. If they become teachers, their positive perceptions are likely to further improve the image of the chemical industry.

These studies suggest that, in the longer term, possibly one of the best ways of securing an improved public image is to raise awareness amongst young people.

A good site visit will encourage some to think seriously about work in industry.

Primary school teachers work hard to enthuse children for science but very few of them have scientific backgrounds. Many admit to low confidence in teaching science. The chemical companies can offer much to support these teachers by providing relevant contexts for teaching and learning in the classroom as well as helping them to improve their knowledge and understanding of science. Few have industrial experience and some are prejudiced against the chemical industry.

Research by Rosemary Feasey(4) at Durham University has shown such prejudices are often present in trainee teachers. She found that a minority was positive towards industry and science education links with a majority showing indifference or hostility. The perceptions of many trainee teachers, however, were improved again following well-designed visits to chemical companies.

It is very important that site visits have a proper purpose and are planned. Many companies will have had experience of a visit that achieves little for both the children's education and the company concerned. Indeed such visits may reinforce the already negative perceptions held by the children. The next section of this document describes current best practice to ensure a successful visit.

Section 1 : Company policy for school visits

Some companies just react to requests for visits as they arise. They have no overall policy. In general, where companies have a visits policy, children leave the site with a much more favourable impression of the company and its activities than they do if the visit is made to a site with no policy and therefore no infra-structure to meet the specific needs of the visitors. Companies with policies often find they can respond more quickly to requests and can plan each individual visit more efficiently.

Research has shown that a visit which has a proper purpose and is planned has a very positive influence on the opinions of pupils. To be justified, visits must create as many positive outcomes as possible in a short space of time for both the company and the school. A visit which does not have a clear purpose or one which is poorly planned is likely to reinforce the many negative images children have of chemicals and the chemical industry. "We certainly noticed the marked difference between the schools where the visit was carefully linked to the work of the children during lessons and others; their ability to question and the quality of their feedback has impressed us greatly". Vanessa Humphrey, Hydro Polymers.

"Their feedback impressed us greatly."

A policy for school site visits will consider:

- the purpose of organising school visits, for the school and for the company.
- the benefits for the company and schools that arise from school visits.
- the number of school visits the company will provide each year.
- how the company will select from:
  - children/students in different age groups;
  - local or more distant schools;
  - science or non-science pupils;
  - school exhibitions and materials.

There are several possible approaches to finding a named contact:

i) A local industry-education organisation can provide a useful platform for finding suitable contacts.

ii) It is worth carrying out a survey of company personnel to identify those colleagues with children in local schools or who are school governors. Find out the names of their teachers and headteachers.

iii) Identify personnel with teachers as partners, neighbours or friends.

"To be effective in communicating our initial interests, we need to be accepted by those within the education community as partners."
Colin Coates, Monsanto.

"Industry can provide real relevance for much of the curriculum teachers deliver in the classroom."
John Adams, Pfizer.

"Industry has a wealth of knowledge and experience from which children and teacher can gain."
Katherine O'Sullivan, teacher.

1.1 Making contact with schools

The first task for any company wishing to initiate school visits is to find interested and enthusiastic individuals within schools. The aim is to establish one to one contact which is undoubtedly the best way to draw up the requirements for a visit.

Once a named individual has been identified, telephone contact can be made and ideas for a visit outlined. The teacher you speak to first may suggest the name of another teacher who they think will be interested.

Another approach is to circulate a leaflet to all schools in your area with an accompanying letter inviting them to consider a visit or, alternatively, inviting interested teachers to a meeting.

Whenever making contact with a school, remember that teachers spend most of their day in front of a class which, usually, they cannot leave. A school secretary may take a message to pass on. Other forms of communication, such as fax or e-mail, may be more appropriate.

Whatever approaches are made, be prepared with clear suggestions of what the company might offer to a school on a visit. The case studies in this document may provide some ideas for suggestions. The company has a valuable opportunity to provide curriculum enrichment for the pupils.

But, be aware that communication barriers may exist, arising from cultural or language differences.

In some EU countries school inspectors are now looking for good industrial links. Try to present a neutral, balanced view and avoid anything that could be viewed as company propaganda. Very many teachers have little or no experience of industry and, like pupils, their perspective is sometimes a negative one. Also, remember there are generally fewer science or technology teachers in schools for pupils under 11 years of age than in schools for older pupils. If printed material is distributed, try to get it checked first (or, better still, written) by a teacher or educational consultant.

Open invitations sent, for example to a headteacher or head of science, may be unsuccessful if these individuals are busy or hold negative views of industry. If this happens, don't be afraid to try again or to speak to another teacher at the school. Once an enthusiastic contact is found, others in the school may well be persuaded. Senior staff will see the value of a visit that enhances well structured work provided by such a teacher.

Once the idea of a visit has been accepted, planning can begin.

1.2 Preliminary visit by a teacher

It is important that the company personnel, teacher and pupils all know why the visit is taking place and what to expect from it. Remember the visit needs careful planning and must have a proper purpose for success! Probably the best way to achieve this is to arrange a preliminary visit by a teacher to company's site.

Such a visit is also necessary where a new school is repeating a well established visit made by another school or when company personnel change. It provides an opportunity to establish personal contacts and ensures that both the company's personnel and the teacher are well briefed. The teacher will also be in a strong position to provide preparative activities and guidance to pupils to ensure that they can make the most of their visit.

Asking teachers what they want from a visit may be more appropriate where the teachers have significant experience of the chemical industry and have a clear idea about how they feel your company may contribute to the education of their pupils. This input can reduce the planning input from the company. Some companies find it helpful for teachers to complete a questionnaire about what they hope the company can offer and what the children may gain from a visit. This can be helpful as some teachers are uncertain as to what to request from a visit.

Before the teacher(s) come on the preliminary visit, if necessary, the host should acquaint themselves with:

- company policy for visits from schools;
- budget allowance, including assistance with transport;
- the number of visitors allowed on site at any one time;
- safety clothing required for issue to visitors;
- where visitors are met;
- arrangements for parking of visitors transport.

The preliminary visit should involve a tour of the plant for the teacher followed by a meeting with the person in the company responsible for organising visits.
The teacher(s) may wish to take back with them company literature and a site plan. So these should be available for the meeting.

Remember the visit needs careful planning

1.3 Preparation of visit with a teacher

The visit may be the young peoples' first real experience of the working world, which can be a very formative experience, especially for the youngest pupils. Thus it is important to plan with the teacher very carefully to ensure this first experience is a positive one. The agenda could include:

Objectives

- shared aims and objectives of visit;
- how the visit links with the curriculum, classroom work and experience before and after visit;
- pupils' knowledge and level of understanding in science;
- appropriate level of language to use with pupils;
- structure of visit, parts of the site to be visited, route and timings;
- explanation of the site in terms of what it manufactures, especially in terms of end/consumer products.

Before the visit

- company literature to help pupils prepare;
- presentation in school.

After the visit.

- feedback and evaluation.

Practicalities

- safety issues, including clothing worn by the visitors;
- date & duration (1.5 hours maximum) of the visit;
- transport arrangements;
- number and age range of the pupils;
- division of pupils into groups;
- names & number of accompanying adults;
- details of any children with special needs or medical problems;
- whether the school might need financial help;
- insurance;
- meeting/other rooms required, resources (video, computer);
- toilets and washing facilities;
- provision of refreshments;
- display materials, including consumer products which rely upon the products of the site.

Publicity

- press release;
- photography.

Ensure that contact names and telephone numbers are exchanged of at least two people at the company and two at the school in case of illness (including home numbers in case a last minute problem arises).

1.4 Preparation of visit within the company

Personnel needed to help with the visit may require motivation, they may resent interruption of their work. Try drawing attention to the enthusiasm generated among those employees mentioned in the case studies. When choosing personnel, key strengths to look for are enthusiasm coupled with the ability to communicate at the appropriate level. Younger pupils will be more comfortable if colleagues are chosen who have children of a similar age. Also, look for those who will provide good role models, matching individuals to the needs of the pupils. Try to ensure a balance between male and female staff. Girls will draw pictures of scientists on returning to school if they meet a female scientist! (Boys tend to avoid drawing people, they prefer to draw machines and buildings.)

Try to provide personnel with similar racial origins to the pupils where appropriate. Employees will often welcome training when working with young people. Teachers from local schools will usually be willing to help in this way.

Once the team of people helping with the visit is agreed, and following the preliminary visit, you will need to circulate colleagues with:

- a statement of objectives for the visit;
- the proposed date and time;
- information about pupils with medical problems;
- practical arrangements for the tour of the site;
- time for a briefing meeting.

At the briefing meeting the following will need to be discussed:

- content of visit and agree any materials needed to enhance pupils' understanding;
- bad weather contingency plan;
- First Aid and emergency procedures;
- how to make the most of the press opportunity.

Employees will often welcome training when working with young people.

It is sensible to build some flexibility in the visit timetable. The visitors may be late in arriving or one part of the visit may overrun. Prior to the visit decide where time could be cut in this eventuality. For example you may choose to cut short on some aspects or to miss out a part of the visit.

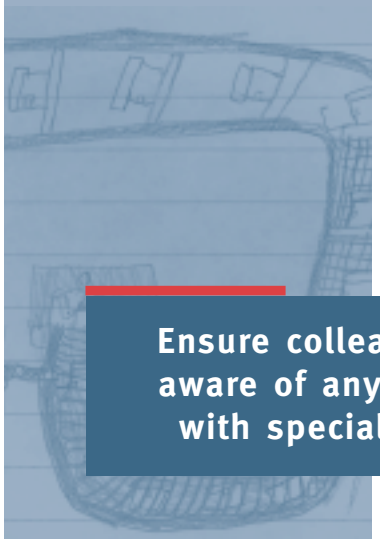
When the company is hosting very young children, a greater number of adults may need to be present on the tour with the children. In addition to teachers, the school may be able to bring some classroom assistants or parents. Otherwise, the company may need to commit more personnel to the visit.

Safety concerns can be at least partly overcome if very young children make a tour of the plant from outside the perimeter fence. On site, they can be kept well away from any hazardous areas and moved round the site by minibus or coach. Despite these difficulties, young children are probably the most amusing and rewarding of visitors.

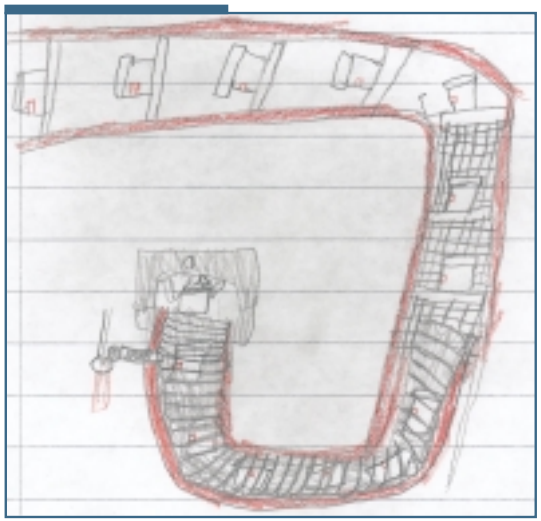
“I like the interactions with the very young children.” Mona Lindstrôm, Sekab. "From a well managed visit, they will take away many positive impressions which are likely to influence their perceptions of industry into adulthood and may even encourage them to become industrial chemists."

In general, encourage all colleagues who will talk to children to avoid talking at them. They should try a more questioning approach using open questions such as:

- What do you think this is for?
- How could we overcome the problem?
- What do you think this sign is telling you?
- Why do you think I would wear these gloves?



Ensure colleagues are aware of any children with special needs.



Children do like amusing anecdotes, so these may be encouraged where appropriate.

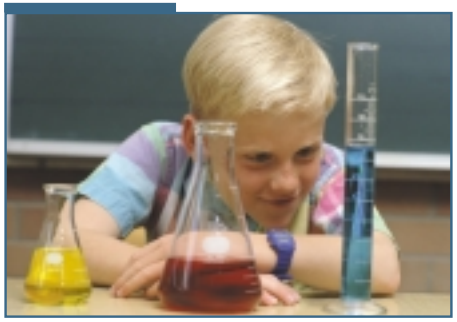
It may be worth arranging a training session for colleagues (run perhaps by a teacher). It is sensible to arrange backup staff in case of absence on the day of the visit. The issues covered at a training session are covered below.

1.4.1 Choosing the most appropriate vocabulary

Personnel helping with the visit may need some help with the level of language required, especially with younger visitors. This should be discussed at the briefing meeting using information provided by the teacher during the preliminary visit. For example, with younger children it is probably better to use terms such as scientists, ingredients and site rather than chemists, chemicals and plant. Also, avoid names of chemicals, use of the terms solid/liquid/gas and most units of measurements. Research has shown that children aged 9-10 years view chemicals as acids or coloured liquids, all being nasty and horrible.

Encourage personnel to face the children when speaking to them and to check that they can all hear and to respond to children who raise their hand to answer a question rather than to those calling out. This helps establish ground rules for behaviour and encourages participation from the quieter children. Also, try to involve equal numbers of boys and girls.

Ensure colleagues are aware of any children with special needs. If children answer incorrectly, try to be encouraging and use phrases like “good/interesting idea” or “you’re on the right lines” or “that’s very close” rather than “no, that’s wrong”.



1.4.2 Challenging children's impressions

Unless the company has professional guides, ask your personnel to outline their careers and their normal jobs within the company. This avoids the children seeing them only as guides.

In some countries children picture an engineer as "a man with a spanner". Where engineers are met on the visit, try to bring in the scientific aspects of their work.

1.4.3 Additional items to check

- canteen advised on numbers requiring refreshments and time required;
- company briefed by teachers on the kind of questions that children will ask on visit;
- method of feedback to the company agreed;
- parents informed and consent obtained;
- any handouts to the pupils organised;
- video computer presentation arranged;
- feedback questionnaires available.

1.5 Preparing the children for the visit

Usually, the teacher will prepare the pupils for the visit during a few introductory lessons. The company may be able to help by providing literature or other materials. A short presentation by a company employee during one of the introductory lessons may also be appropriate.

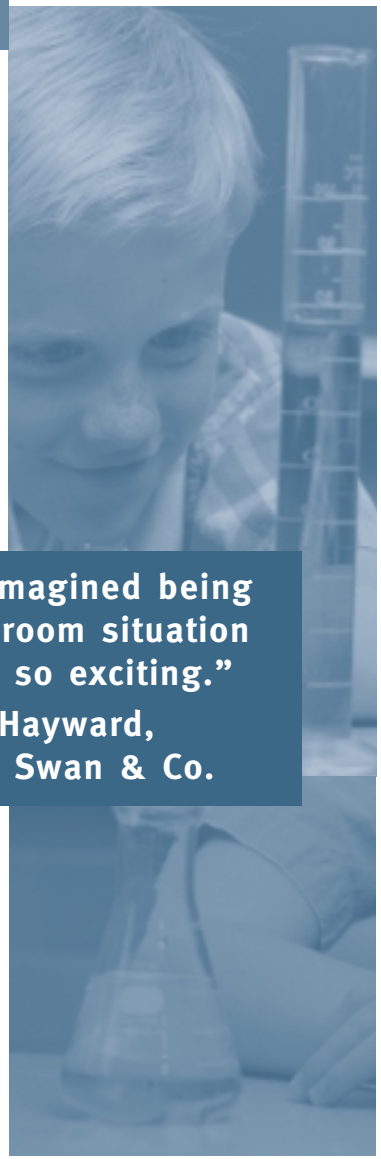
Unless your employee is experienced in making presentations to children of the age group making the visit, careful discussion should take place between the employee and the teacher as to the level and approach to use. A good idea for a short activity during the introductory lessons is to suggest that the children could describe (and draw pictures) of what they expect the company to be like. This will provide an excellent yardstick for evaluation after the visit.

1.6 During the visit

Maintain a light touch throughout the visit, beware of side tracking from aims and objectives.

Keep to agreed timing - overrunning on one aspect will significantly squeeze and reduce the quality of other aspects. Keep groups to a suitable size so that all visitors can see and hear. Move to a quieter location when talking to groups. Ask questions to involve pupils and to check they have understood what has been said. Make the input relevant, use humour and anecdotes and relate what is said to the pupils everyday knowledge and experiences. Involve the visitors as much as possible. Make handouts available of any slides used in presentations.

"I never imagined being in a classroom situation could be so exciting."
Dai Hayward, Thomas Swan & Co.



1.7 Feedback from the school

Schools may need to be prompted to provide feedback. However, once the request is made they are usually pleased to respond in a variety of ways such as:

- teachers and pupils writing letters to say what they learnt or enjoyed the most;
- pupils creating drawings, paintings or posters;
- writing an article for a local newspaper, company journal or school newsletter. Local newspapers like to publish reports by groups of children who have made an interesting outside visit. Clearly, such a report will be enhanced if you have been able to arrange photographs;
- the pupils may make a presentation at the school or site. The invited audience could include: tour guides, company chief executives, school governors, headteacher, other pupils, parents, councillors or the press;
- prepare a display of work for use in school and in appropriate places on the company site (such as foyer, canteen or library).

Samples of such work and copies of any written reports should be requested for company records. You may find that some of the pupils' work is useful for publicity or for demonstrating your involvement with the local community.

Evaluation is an essential part of the process of ensuring visits are successful. It is important to try to evaluate each one, or at least a random selection. Company staff, pupils and teachers should all be asked for their responses to the visit. This ensures that the evaluation is balanced and reflects the views of all. Objective feedback is best gathered by means of questionnaires. If these are simple enough, they can be completed at the end of the visit (perhaps during refreshments).

For young children, the smiley faces approach can be used where the children draw the smile on a pre-drawn face (as used in visit 1 from the 6-12 year case study ☺ liked visit 😐 it was OK ☹ did not enjoy visit, on page 22).

More sophisticated questionnaires would need to be taken away (remember to provide a stamped addressed envelope). Structured interviews might also be used. The above feedback section provides more subjective material for evaluation.

Measurement

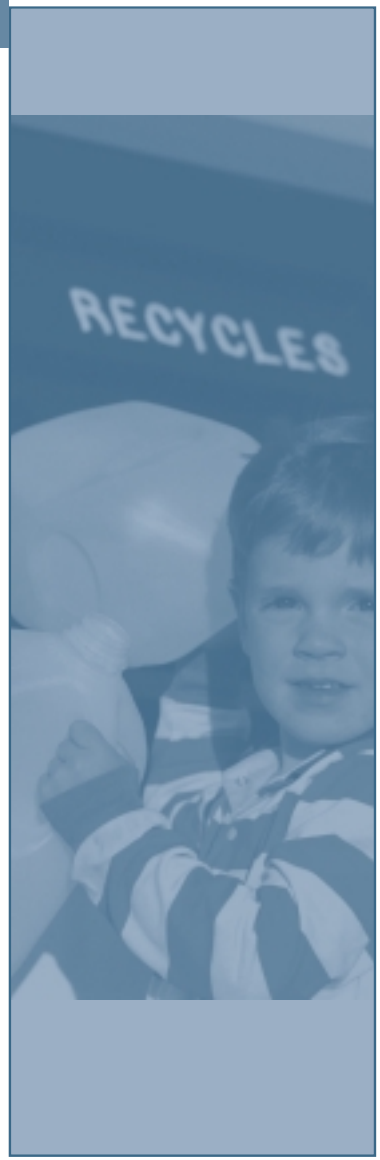
A few ways that quantitative measurements might be made to assist evaluation include:

- record the number of requests received for site visits over time;
- measure against the agreed visitor objectives;
- measure column centimetres in local press;
- changes in perception or attitudes to company recorded from nature of community letter received.

1.8 Further co-operation

Following a successful school visit, the company may be approached by the school seeking cooperation in a number of different ways. These could include:

- ongoing visits by pupils as they move up the school;
- requests for work experience/shadowing by pupils;
- an industrial placement for a teacher;
- project work by pupils related to what they have seen on the visit.



Section 2 : Case Studies

Introduction

Each case study focuses on a particular age group and consists of a number of visits which have different themes. All the visits have the following key features:

- they have a very clear focus;
- they are carefully planned;
- they are linked to the school curriculum.

Case study 1 shows that, by focussing on a general theme such as safety, successful visits are both desirable and possible even with the youngest pupils.

In many companies, the chemical processes carried out will be too advanced for young children. This case study demonstrates that exciting, highly successful visits can be made by linking the visit to a context such as safety, storage or measurement.

Case study 2 demonstrates how older pupils benefit from more specifically focussed visits which look at the applications of chemistry to our daily lives.

The oldest pupils (Case study 3) have had time for their knowledge and understanding of chemistry to have developed sufficiently for chemical and chemical engineering aspects to become accessible. An overview of each case study and the visits it contains follows.

Case Study 1

The best age for a visit within this group seems to be 9-10 years. Comments from teachers include: "I feel less isolated when teaching science" and "The pupils responses were amazing."

Visit 1.1 describes a visit with the youngest school children for age 6-8 years. During this visit the pupils learnt about safety and the need for special clothing. They all dress up in the clothing and they related what they know about safety equipment at home (oven gloves) and at school to clothing on the site. Preparative work included comparison of the insulating qualities of different materials. Following the visit children made drawings of themselves in the safety clothing. Considerable press coverage followed the visit.

Visit 1.1

Age group:	6-8 years
School:	Alne
Teacher(s):	Ulrica Westin
No. of pupils on visit:	13
Length of visit:	about 2 hours
Overall time:	about 2 weeks
Company visited:	Akzo Nobel and SEKAB (an ethanol chemical company)
Business:	Chemical manufacture
Focus of visit:	Safety clothing
Curriculum links:	Properties of materials
Support Materials:	CIEC Exxon Site-seeing Safety pack(4). Chemistry is Magic or the Saga of Gilbert(7).

Initial company response

Whilst Akzo Nobel had experience of visits by older children, company personnel were initially uncertain about hosting a visit from such young children. However, this initial anxiety gave way to much enthusiasm after the visit. This enthusiasm arose from the responses of the children themselves as well as the ensuing press publicity.

The Exxon support materials helped to overcome initial anxieties over safety and uncertainties of company personnel over the value of a visit by such young children. It became clear that the visit would focus on people working on the site, the different buildings and the different types of clothing required for safe working. As the children did not need to see the chemical production areas, they would always be well-separated from hazards.

Preparation before the visit in school

Lesson 1 An introduction to show chemistry is fun

The children made a landscape (from paper mache) with a volcano (using flour dough). This was used to show the children the first experiment from “Chemistry is Magic” (the volcano is filled with coloured baking powder and acetic acid is added). This was followed by the second experiment from “Chemistry is Magic”, in which the shell of a whole, fresh egg is dissolved in acetic acid.

Remainder of lesson 1 and lessons 2 & 3

The following activities were rotated round different groups of children.

a The children sorted a range of safety clothing using hoops and ready made sorting labels showing pictures of items. Clothing sorted included cycling helmet and glasses, riding hat, swimming goggles, painting aprons or sleeves, oven gloves, raincoat, rubber boots, waterproof anorak, ski jacket and trousers, knee and elbow pads for inline roller skating.

b They carried out tests on materials such as paper, cotton wool and bubble pack.

The tests were based on the simple methods described in the Exxon Safety pack. The materials were tested for their insulating properties; how well they kept out water; how much protection from breaking they gave when used as wrapping. A numerical scale of 1 to 5 was used as well as smiley faces. Samples of material were stuck onto a card next to the faces and name of the material.

Towards the end of lesson 3

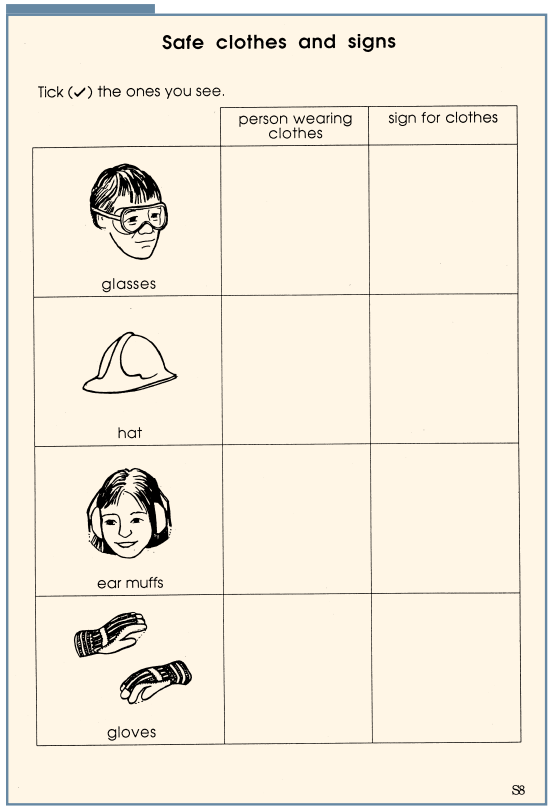
The children made drawings of what they thought they might see on the visit.

Activities during the visit

A short discussion took place about familiar situations at home where safety was an issue. This was followed by discussion of the colours of safety signs seen at school. Next they watched a short safety video. The video was stopped at intervals as a different part of the plant was reached. When the video was stopped, they were asked to look out for signs and safety clothing. This showed them the different signs and clothing needed in the various parts of the plant. The two personnel from the company (Karin Nytorps and Mona Lindstrôm) both had children of similar age to the visiting children. This enabled them to use a very appropriate level of language throughout the visit.

The children dressed up in a wide variety of safety clothing. Almost all of the children were very happy to dress up. Only one, shy child held back, eventually trying on some gloves and ear defenders. They were also given different types of glove to sort according to the type of protection given.

The children walked round the outside of both Akzo Nobel and Sekab looking at buildings (for making adhesive at Akzo Nobel and acetic acid at Sekab). They were able to see safety clothing in use where a new building was being put up outside the perimeter fencing of the two companies.



Safe clothes and signs

Tick (✓) the ones you see.

	person wearing clothes	sign for clothes
glasses		
hat		
ear muffs		
gloves		

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Following the visit

Some quotes from the children were:

"I thought the video was scary."

"The video was good."

"I would like to do some more experiments with Gilbert."

"It made sense of what we were doing in lessons."

The boy found the video scary because it showed a man washing something out of his eye. The children also completed questionnaires. These questionnaires made use of smiley faces for the childrens' responses. The responses were very positive and some are shown in the table below.

Drawings were made of themselves wearing safety clothing. They were given a survey on oven gloves to do at home (from Exxon pack). The company personnel involved all found the experience of the childrens visit worthwhile. However, they found it difficult to know whether the children understood all that was said to them. The small groups were an advantage and the topic was accessible to the pupils. The pupils response gave much pleasure to the staff. The company said they would be willing to host similar visits in the future.

Ulrica Westin made a presentation to other trainee science teachers. This presentation received a good response from these trainee teachers. The local paper ran the story on their front page and continued the story within the paper. They used many lively photographs of the children dressing up in the different types of safety clothing.

Question	Enjoyed	It was O.K.	Boring
Did you enjoy the experiments from "Chemistry is Magic"?	20	5	1
Did you understand the experiments?	18	4	2
Did you find the experiments interesting?	23	1	2
What did you think about the visit?	25	1	0
	No		**Yes**
Was it scary to wear safety clothes?	24		1
Do you want to learn more about chemistry?	0		26

Visit 1.2

Age group:	9-10 years
School:	Alne
Teacher(s):	Ulrica Westin
No. of pupils on visit:	27 of whom about 13 had some degree of learning difficulty
Length of visit:	about 2.5 hours
Overall time:	about 2 weeks
Company visited:	MoDo Husum
Business:	Paper manufacture
Focus of visit:	Storage
Curriculum links:	Technology and IT
Support Materials:	CIEC Exxon Site-seeing Storage pack(5).

Initial company response

A local Industry Group provided Ulrica Westin with a contact name. Ulrica Westin telephoned this contact to arrange a meeting. At first MoDo staff were very sceptical about a visit by children from this age group. They only had experience of visits by older children. By the end of the visit the MoDo staff had completely changed their opinions and felt that the visit had been "very successful".

Preparation before the visit

Lesson 1

In this lesson the children sorted different papers and cartons using criteria such as whether it was suitable for wrapping or printing. Also if it was labelled recyclable. They described the typical properties needed for each criterion.

Lesson 2

In this lesson the children made paper. To do this they tore up newspaper and soaked the pieces in a bucket of water. The paper pieces were rubbed together with soap and then sieved from the water and the wet mass was spread out to dry.

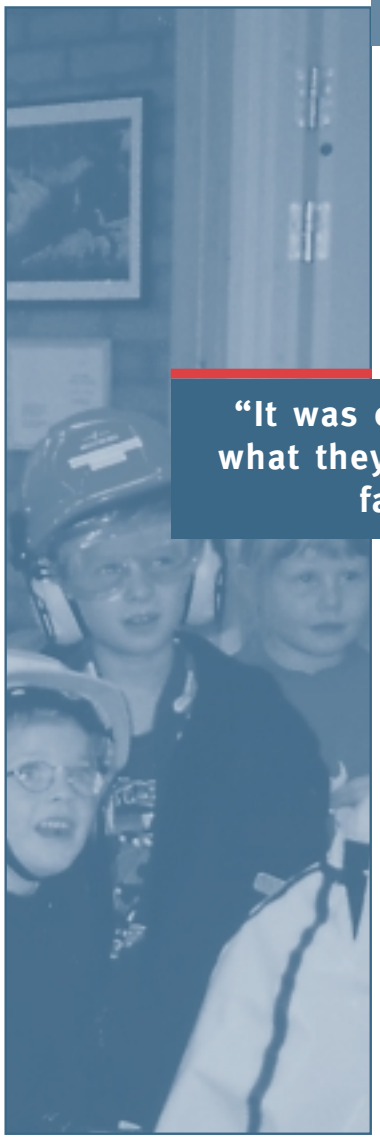
Lesson 3

In this lesson the looked out how things might be stored at home. For example rice, macaroni, paper clips, pins. The aim was to suggest, with reasons, systems for storing these items.

Activities during the visit

On site, a bus tour enabled the children to see the industrial plant and other premises. They were divided into three groups that visited three different units in turn.

Visit 1.2 focussed on paper and storage of equipment. Prior to the visit, the children made paper and looked at storage at home. On the visit they toured the plant by bus, saw how resources were stored and managed in a warehouse and used construction kits to build storage systems.



They visited a warehouse to see how resources were stored in different sections. The pupils used the numbering system to find a specific item. They saw how the computer could be very useful in doing this. Following the warehouse, the pupils sorted and stored different pieces of equipment into different boxes before going on to see how paper is packed into boxes.

"It was exciting to see what they did in the big factory."

The company also purchased four construction kits from Quadro in Germany. These were used to construct various storage shelves in different designs. These kits were used by the pupils for the work on measurements and on storage.

Following the visit

The pupils completed questionnaires about their activities and what they had seen. These questionnaires showed that the pupils had found both the lessons in the classroom and on site tours interesting and very entertaining. More girls than boys described the site tours as "very interesting", most boys simply said they were "interesting".

MoDo staff felt that this visit and Visit 1.3 were very successful and observed that the children showed great enthusiasm and excitement whilst on site. The teachers involved in both visits were also very excited and said that they would be pleased to repeat the visits. Also, the company said they would be willing to host similar visits in the future.

Visit 1.3

Age group:	11-12 years
School:	Alne
Teacher(s):	Ulrica Westin
No. of pupils on visit:	about 25
Length of visit:	about 2.5 hours
Overall time:	about 2 weeks
Company visited:	MoDo Husum
Business:	Paper manufacture
Focus of visit:	Storage
Curriculum links:	Technology and IT
Support Materials:	CIEC Exxon Site-seeing Storage pack(5).

Activities before the visit

This visit was very similar to Visit 1.2 except that the children were one school grade higher.

The main differences were in the lessons before the visit.

Lesson 1

Using two books of different size, the children timed how long it took to pick them up and calculated how long they would spend doing this over a year. They then timed how long it took to tidy their desks.

Having tidied their desks, they made a plan of where they had put everything inside it. This was repeated a week later and they noticed how much less time it took.

Lesson 2

This was as lesson 1 in Visit 1.2 with the addition of different quality papers for different purposes. For example, the different types of paper used for printing in newspapers, magazines and books.

Lesson 3

In groups they discussed how to improve the order of materials in the classroom and drew plans of how they would choose to do this. In the class discussion that followed each group described their plan and explained why they chose it. The group with the best plan were allowed to use it to reorganise the classroom.

Activities during the visit

These were as Visit 1.2.

Following the visit

As for Visit 1.2, the pupils completed questionnaires about their activities and what they had seen. These questionnaires again showed that the pupils had found both the lessons in the classroom and the site tours interesting and very entertaining. It was clear that the younger children were more excited by the visit than the older children. However, the older children "liked the visit a lot". It is possible that the focus of the visit was at too low a level for older children.

Visit 1.3 focussed on measurement as well as storage. As Visit 1.2, the children made paper but they looked at different papers for various purposes. They made measurements involving time and considered how best to reorganise their desks and the classroom to save time. The visit was similar to Visit 1.2.

Visit 1.4 also focussed on measurement. Prior to the visit, the children had a talk from a company employee. They examined the quality of different papers and also did work on finding the weight of moisture present in paper. The weighing theme continued on the visit, culminating in finding the weight of the whole class. They saw paper being made, visited a storage area and saw how this was arranged in relation to the weight and volume of the items.

Visit 1.4

Age group:	10-11 years
School:	Alne
Teacher(s):	Ulrica Westin
No. of pupils on visit:	about 25
Length of visit:	about 2.5 hours
Overall time:	about 2 weeks
Company visited:	MoDo Domsjo
Business:	Paper manufacture
Focus of visit:	Measurement
Curriculum links:	Maths
Support Materials:	CIEC Exxon Site-seeing Measurement pack(6).

Preparation before the visit

Lesson 1

Hans-Erik Wagberg came to the school to talk to the children about the company and their work in preventing damage to the environment. He also stressed security and safety aspects. Afterwards the children said that they liked somebody different coming to also talk to them.

Lesson 2

The class was split into groups of pupils. Each group tackled a different task using a range of papers. The tasks were:

- the paper was torn and the fibres examined;
- the weight of the paper was found before and after drying and the weight of moisture present calculated;
- the quality of the papers were compared.

On completion of the tasks the groups described their findings to the rest of the class.

Lesson 3

The children were asked to guess the weight of various objects which they then weighed. The objects were sorted taking into consideration their weight and volume.

Weigh bridge ticket

Weighbridge ticket	Number _____
Cubitt	The Cubitt Company Longton Site Dafdon, Cumbs. CU6 LD4 Telehone: 0123 654321
Description of goods	
Customer	
Lorry company	Lorry registration
Order number	Remarks
Weigher's signature	Driver's signature

Activities during the visit

They arrived at the factory by bus. Using the company weighbridge, the bus was weighed empty and then reweighed with the children on board. The pupils calculated the total weight of the class. The class was also weighed on a large scale for weighing paper. The class was divided into three groups. One group saw the paper mill. A second group worked in a conference room where they weighed paper and other articles. They used the measurements to look at the relationship between weight and volume. The third group visited the storage area and saw how this was built taking into consideration weight and volume. A forklift truck was seen lifting items which were stored so that heavier items were lower down. The driver of the fork lift truck was female. This group were also shown the computerised data storage system and how it could be used to find an item.

Following the visit

The company said they would be willing to host similar visits in the future. Hans-Erik Wagberg was pleased with his talk to the children. Overall, Ulrica Westin was not quite so satisfied with this visit compared to Visits 1.1 to 1.3.

Visit 1.5 also involved older pupils (age 17 years) who acted as tutors. The aims of this initiative are to show the pupils that chemistry is of fundamental importance to our daily lives and to demonstrate that the industry provides a variety of interesting and stimulating career opportunities.

The tutors raised awareness of the interest and excitement of chemistry by presentations of chemical experiments. Further experiments with household chemicals were followed by the writing of reports by the younger pupils. During the visit, the pupils saw the manufacturing of plastic laminate for floor tiles. The continuing programme of work involves study in school as well as another site visit to look at recycling polymers. Very positive feedback followed this visit.

Visit 1.5

Age group:	9-10 years and subsequent years
School:	Parkskolan & Perstorp Gymnasium
Teacher(s):	Christina Bergvall, Karin Olsson, Johnny Olsson, Mats Salomonsson
No. of pupils on visit:	about 25
Length of visit:	about 2.5 hours
Overall time:	about 1 week plus the visit
Company visited:	Perstorp
Business:	Plastic recycling and flooring
Focus of visit:	Making floor tiles, recycling plastic
Curriculum links:	Science, also Swedish, History
Support Materials:	Material created by a local teacher.

Company perspective

Young people in Perstorp have been unwilling to work in industry. In the past, many industrial employees had little education and consequently performed menial tasks. This produced a very negative perspective of poorly paid industrial employees. The company was naturally concerned about the future recruitment of well-educated employees, especially in view of the increasing importance of computers. Tasks in industry are becoming increasingly complex requiring greater degree of responsibility and employees need both practical and theoretical skills.

In response to these concerns, this project was initiated by the company in 1996. They arranged a meeting with teachers from the local community and planned the whole venture together with the teachers. The company wished to have a long term scheme which started with pupils age 9-10 years and continued up to age 17. The main purpose of the project is to emphasise, at an early stage, the importance of chemistry in our daily life and at the same time show that chemistry is an interesting field for further studies.

Outline of project

For pupils age 9-10 years.

The pupils visited the factory where they saw the manufacturing of laminate for floor tiles. They made a tour of the plant by bus and learnt about the company's history. The visit was followed up with written work on the company's history.

For pupils age 10-11 years.

Older students (age 17) from the Perstorp Gymnasium visited the school to show children the fun of chemistry with demonstration experiments. Some of these experiments used came from "Chemistry is Magic". The purpose of these demonstrations was to raise interest in and awareness of chemistry and of the opportunity to study the subject at the Gymnasium. The pupils were very enthusiastic about these experiments, especially the "Dish snake" and "The Dirty Air of Cities" from "Chemistry is Magic". The older students could see how well they were able to plan and explain the demonstrations to the children. They also showed their willingness to take responsibility.

The demonstrations were followed by a day where the pupils tried different experiments using chemicals found in the home. The students were the tutors, who helped and inspired the

pupils. Following the experiments the pupils wrote reports which they sent by e-mail to the students.

In their last lesson with the students, the pupils visited the Gymnasium and used some of the science equipment. The young pupils also found out what it was like to be a Gymnasium student.

During these activities, boys and girls were in different groups. The teachers had observed that this gives the girls more opportunity to be seen and heard. Following such segregation a girl commented “When the boys are with us they say things without thinking, now we get a chance."

Pupils age 11-12.

Competitions take place as well as meetings with teachers from the Gymnasium.

Pupils age 12-13.

The pupils visit the company to look at recycling plastics. They collect samples before the visit to take with them. They were able to add the plastics they had taken to the recycling process. They saw their own plastics being recycled.

Pupils age 13-15.

Pupils spend a week with Perstorp AB. They follow the work of employees, meeting different people over the week. These employees are chosen to suit the interests of particular pupils.

Following the visit

Questionnaires showed that more children have a clear idea about the nature of chemistry, linking the subject to experiments. More children understood the value of learning about chemistry and wanted to learn more. A number were also expressing a wish to work within the chemical industry. Comments from a control group of children, not involved in the project, included “I think it is dangerous” and “I don’t think I can benefit from it”. During the project, the children were very enthusiastic and interested, always looking forward to the next activity. Perstorp staff were also very enthusiastic about this project and continue to support the project, holding two meetings each term for planning and review.

Visit 2.1 focused on flavours and fragances. Whilst the main theme was chemical, this visit had an interdisciplinary approach that helped to show how chemistry benefits our daily lives. The visit was part of a large project involving pupils working at school and in a University laboratory as well as including a site visit.

The children studied vanilla in view of its wide use in different products. They extracted vanilla from vanilla pods, synthesised pure vanillin and went on to blend their own perfume before making a visit to a company making soaps and cosmetics.

This visit had very positive outcomes, especially as it took place with an educationally disadvantaged group of children.

ben

Visit 2.1

Age group:	13-15 years
School:	College Jean Moulin, Le Havre.
Teacher(s):	Sylvie Riou and team
No. of pupils on visit:	17 girls, 11 boys
Length of visit:	day trip, 2 hour tour
Overall time:	about 2 weeks
Company visited:	Sanofi Beauté Recherché & Industries, Bernay, East Normandy
Business:	Perfumery, production of soap and cosmetics
Focus of visit:	Real life R & D, production of soap and cosmetics
Curriculum links:	Mainly Chemistry, also Biology, Geography, English, French and Art.

Initial company response

The school had been advised to complete the project with a visit to a local company. This advice had come from the l'Union des Industries Chimiques and the Ministère de l'Éducation Nationale. Various companies were approached for help but none were able to co-operate. Perfume manufacturing is an exclusive activity and many companies closed their doors for the sake of secrecy. Initially Sanofi (a member of the Elf Aquitaine group) also refused to host a visit. However, through personal contact and help from Elf Atochem, Sanofi agreed to a visit taking place.

Pupils background and aims of visit

This visit was the culmination of a project during lessons in school as well as the creation of a new vanilla perfume (Préambule) with the help of the Aroma and Fragrance Department at the University of Le Havre. The pupils at the school came from very diverse social and cultural backgrounds and live in an educational priority area (Zone d'Éducation Prioritaire). It was the intention to enter the project for the CEFIC Science Education Award 1998. Taking part in such a project provides an incentive for the children to value their education and to become more involved in their schoolwork. The project provided a stimulating introduction to chemistry for the pupils in the 3rd year and was completed during their 4th year. Overall this project occupied roughly 30 hours of chemistry lessons.

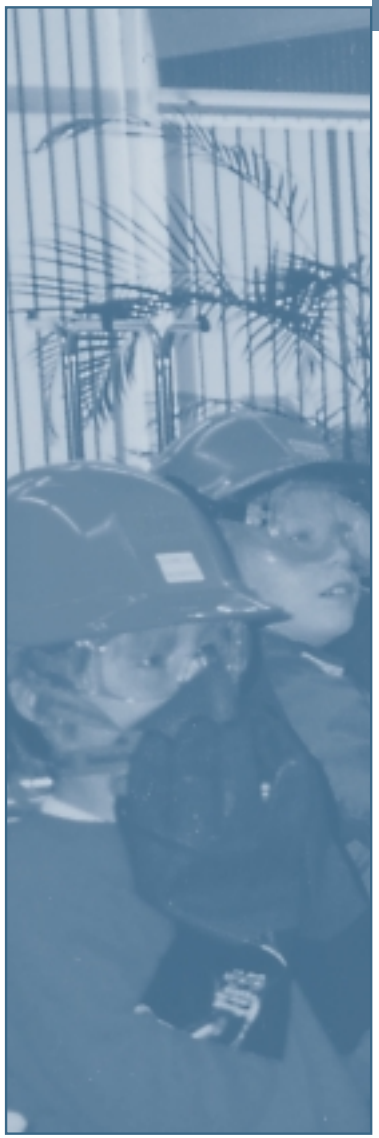
In Le Havre, the chemical industry is part of the landscape and pupils are accustomed to the peculiar odours and coloured fumes from some of the factories. Thus, they began the project with these negative perceptions. One objective was to show that chemicals were beneficial to our daily lives as well as a force for progress in many branches of science. A second objective was to show that the production of foods, medicines, and many other consumer products was dependent on the work of chemical engineers.

Preparation before the visit

The focus of the project was primarily chemical but was extended to other subjects to show how these were also involved. The pupils showed great enthusiasm in the competitive aspect of the project. They were also eager to carry out experiments in university laboratories. Vanilla was chosen as a focus as its sweet smell can be detected in a number of everyday consumer products. In particular, youngsters have developed a passion for the flavour which has led a French newspaper to dub the phenomenon "Vanillomania". First of all, the pupils carried out surveys in their local supermarket to identify products containing vanilla. They discovered the existence of both natural and artificial vanilla flavouring and consequent difference in the price of each for similar products. Odour tests in class introduced them to new vocabulary.

In French literature lessons, the pupils explored passages containing references to the senses, especially the sense of smell. This helped them to develop their vocabulary when describing feelings. In Biology lessons they studied the botanical aspects of the vanilla orchid. The pupils also studied the olfactory system which led them to make hypotheses about the sense of smell. After discussion of the various possibilities, they agreed that the brain played a major role. Experiments were suggested and data from clinical studies helped to verify their hypothesis. In this way the became more aware of how experimental procedures can help to solve scientific problems.

The pupils visited Le Havre University where they worked in groups to extract the essential oil from vanilla pods by soaking them in water prior to reflux. Other solvents such as



alcohol, ether or hexane were also tried. Graduate students introduced the pupils to the basic chemistry and equipment such as reflux and rotary evaporation. The product was analysed by chromatographic techniques. Next, under the supervision of the graduate students, the pupils synthesised samples of pure vanillin. They realised that this substance was more concentrated and stronger tasting than the natural product.

The importance of the English language in science was brought home in the University library, where the pupils noticed a large number of English books. The University graduates also explained the necessity of being able to work with English texts. This prompted written and oral exercises in class, including a letter describing the work in the lab and presenting the project to an imaginary English-speaking class.

From a geographic standpoint, they looked at natural vanilla as a commodity. This involved studying the vanilla trade, the farming of the orchids and drying of the pods, world trading routes and economic/financial aspects.

This project won first prize in the 1998 CEFIC Science Award competition. The judges particularly liked the way the project crossed curriculum boundaries.

Creating the perfume

Then the fun really started! Armed with a selection of fragrances, the pupils went back to the University labs to start creating their own perfumes. The professor in charge of new products introduced this stage, explaining the make-up of a perfume with its top, middle and bottom notes. This enabled the group to calculate the exact quantities of ingredients required for their own compositions.

The painstaking elaboration process followed and, with the addition of vanilla and, finally, musk to make the fragrances “hold” longer, the products were ready for final selection. After lengthy discussion, the class voted for the perfume they preferred. This was then made up in sufficient quantity for distribution to all (about 6 litres).

Designing a container required as much attention as making the perfume itself. First, creative teams - the chemist, the “nose” and the designer - had to be agreed and the interaction between the perfume and the packaging and end-user considered.

The pupils moulded plaster around suitable bottles to create a variety of containers with different shapes and textures. A visit to a perfume museum at the Chateau de Chamerolles nearby demonstrated the allure of a magical and mysterious bottle top. Plaster, cardboard, plastic and even ping-pong balls were brought into service to created the desired effect.

At the same time they considered the product name. They finally agreed that it should evoke the following experiences:

- a first step in the world of chemistry;
- a first encounter with university life;
- a first experience in perfumery;
- a first attempt at working with a new material.

"Préambule" seemed to fit exactly.

Activities during the visit

Finally, the time had come for a visit to a factory. The class had the opportunity to see real cosmetics production at Sanofi Beauté & Industries. The company makes perfumes under the Roger & Gallet, Van Cleef & Arpels and Oscar de la Renta brand names. Sanofi also specialises in soaps and cosmetics.

The visit started in the company's R & D laboratory where:

- different lots of raw materials are classified in terms of scent;
- the perfumier and the purchaser choose the best sample on the basis of quality and price;
- the density, refractive index and colour are checked and bacteriological tests carried out;
- the compatibility of the scents with the packaging is studied;
- blends are made of different natural and synthetic scents to produce a pleasing combination that will become a perfume.

Once a composition has been decided, the data is scaled up for mass production. After mixing the raw materials, the mixture is left to settle in vats. This helps the full fragrance to develop. After filtering, the perfume is transferred by pipes to automatic bottling and packing units. At all stages, experienced operators were seen to be ensuring the final quality of the product. The pupils were able to see the similarities in this process to their own work.

At the end of the visit, the pupils assembled in a meeting room and received courtesy samples as well as refreshments.

Visit 2.2 involved a number of separate visits by different groups of children. Again the focus was on chemistry in our daily lives. The pupils investigated how chemistry and chemicals were encountered in most aspect of a typical day before making visits to local chemical companies. Their enthusiasm for chemistry is very evident from this video.

Following the visit

Several goals were achieved:

- the teachers thought the pupils' first contact with chemistry was very positive;
- the pupils realised chemistry was not just a new school subject, it gives work to many people and it can be found everywhere; without chemistry the world would not smell and taste good;
- motivating and intensive team work was possible, among the pupils but also with teachers, university students and professors;
- working out of the classroom was motivating where it involved seeing and doing things related to work in school;
- much cross-curricular work was achieved. The chemistry and biology teachers were both able to talk about different aspects of vanilla. The geography teacher contributed knowledge about farming and supplying vanilla pods. Pupils were able to explore their sense of smell and relate this to their emotions through literature and art;
- Pupils had contact with a wide variety of jobs ranging from skilled workers to engineers and professors.

Visit 2.2

Age group:	15-16 years
School:	Ytterbyskolan, Ytterby, Sweden
Teacher(s):	Mona Gidhagen
No. of pupils on visits:	Groups of 3 students visited different companies
Business:	Chemical manufacture or processes using chemicals
Focus of visit:	Chemical aspects of everyday life
Curriculum links:	Predominantly Chemistry, also English, and Art.

Aims of project

- to show pupils just how much of our daily lives is

affected by chemistry;

- to increase pupils knowledge of everyday chemical substances and their effects on the environment;
- to provide an opportunity to visit a local chemical manufacturer or to a company using chemistry in their production processes;
- to train pupils to work independently and take responsibility for their work.

Visit 3.1 was linked to a course (Salters Advanced Chemistry) which incorporates a study of the chemical industry based on a student's experience of a visit. The course materials supported both the teacher and the company in setting up the visit. Visit 3.1 is to an agrochemical manufacturer and provided students the opportunity to see the process development laboratories, pilot plant and final production plant for a specialised insecticide.

Visit 3.1

Age group:	17-18 years
School:	Long Road Sixth Form College, Cambridge, UK.
Teacher(s):	Brian Ratcliffe
No. of pupils on visit:	12 to 16
Length of visit:	1.5 to 2 hours
Overall time:	1 week
Company visited:	AgrEvo, Hauxton, Cambridge
Business:	Research, development & manufacture of pesticides and fungicides.
Focus of visit:	To see the process of R & D from lab scale through pilot plant to full scale production
Curriculum links:	Chemistry, how the chemical process industry operates
Support materials	Salters Advanced Chemistry Chemical Storylines(8) and student Activity sheet from Activity and Assessment pack(9).

Initial company response

Through Brian Ratcliffe the College Chemistry Department had links with the company on this site for over ten years prior to this visit. The first occasion that this visit took place was during the trial of the new Salters course. Brian Ratcliffe telephoned one of his contacts and arranged a meeting with company personnel. At the meeting, materials from the Salters course were shared with industrial colleagues. These were discussed in detail so that a carefully planned visit by students could take place. A tour would be made of process development and production. As production is on a relatively small scale and was close to the laboratories and pilot plant, little time would be lost moving from one area to another. This was a real advantage as time was limited. The students would be well prepared with questions about the company and the process which they would see. All those involved could see the potential of this visit in raising the students understanding of both chemistry and the chemical industry. Everybody was very excited about this prospect, particularly because of the way it linked to the syllabus. The company were given copies of all the course materials for reference. Regretably, it would not be possible to take photographs on site for security reasons.

Preparation before the visit

There were three stages. The first two stages took about one hour of lesson time. The first stage was to introduce the students to the chemistry of the manufacturing process they would see. The product is clofentezine, an insecticide for the control of red spider mite used, for example, on orange trees. Where possible, the reactions were explained in terms of chemistry familiar to the students. Condensation, substitution and oxidation reactions are all involved and could be recognised by the students.

The second stage involved briefing the students on the information they should seek on the visit. Questions centred around the headings such as:

- the product and its use;
- the different types of employees needed;
- plant location;
- the development of the process and the final choice of optimum conditions;
- raw materials and energy requirements;
- plant construction materials;
- safety;
- pollution control and environmental protection;
- costs.

The responsibility for questions under any one heading was taken by individual students, the students organised who was finding out about what. Everyone knew that they would be reporting back to the whole class.

The third stage was set for homework. It involved the students in reading and solving short problems from their Chemical Storyline text(8). This stage provided an overall perspective of the importance of the chemical industry together with much relevant discussion.

During the visit

The tour started in a meeting room where a brief overview of the company and the product was given. On later visits a short video was shown which gave an outline of the search for a new pesticide through to its production and use in the field. Safety clothing (white coats and safety glasses) was issued and the students split into smaller groups before the walking tour started. The tour included a visit to the process development department where students saw glass equipment being used to make small quantities. Next, a visit to the pilot plant where the problems arising from scaling up were sorted out. Finally they saw the manufacturing plant for the full scale production of clofentezine. Here it was necessary to put on plastic covers to footwear. An unexpected problem occurred on the first visit when a group of students stepped outside onto a staircase and discovered that one of them was very afraid of heights. During the tour individual students sought the answers to their questions from the various personnel they encountered. The students took clipboards and paper so that they could record these responses. At the end of the visit, there was usually time for some refreshments in the meeting room and a chance to make sure that everyone had all the answers they required.

Following the visit

A class discussion took place on different ways of presenting the individual students findings. As IT facilities had become more available in College, they opted to use word processing to write about their individual findings. One student then undertook to combine all the individual reports into a single document, which, after a little tidying up was printed and photocopied for everyone. A letter of thanks (with comments from individual students) together with a copy of the class report was sent to the company.

Consolidation of everything learnt from the visit came when the homework problems were marked and discussed in class. The students were now well prepared for examination questions about the chemical industry. The visit took place at the end of their first year of study for advanced chemistry and proved to be the highlight of the year for the students. They were all sufficiently well informed to explain to other people the value of the chemical industry to our daily lives.

Visit 3.2 involved students in the study of aspirin. This visit was to the research and development site of the same company as Visit 3.1. The primary purpose was to enable students to obtain both chromatographic and spectral data on samples of aspirin that they had prepared. The visit to see the use of relevant equipment and the subsequent interpretation of the data obtained was part of their programme of learning about the various techniques.

Visit 3.2

Age group:	17-18 years
School:	Long Road Sixth Form College, Cambridge, UK.
Teacher(s):	Brian Ratcliffe
No. of pupils on visit:	12 to 16
Length of visit:	1.5 to 2 hours
Overall time:	2 weeks
Company visited:	AgrEvo, Chesterford Park Research Station, Saffron Walden
Business:	Research into new pesticides and fungicides
Focus of visit:	Analysis of aspirin samples, prepared by students Using mass, infra-red, nmr spectroscopy and hplc
Curriculum links:	Chemistry, visit relates to organic synthesis and product characterisation.

"I found it not only interesting, but also relevant to our classwork, and the syllabus."

Initial company response

Very responsive, primarily as this visit was not the first made by Long Road. The visit was to the research laboratories of the company visited in Visit 3.1. A prior visit was made by the teacher to outline the work being done by students in class and how the company could help with this study. Following this meeting the company agreed to analyse student samples of aspirin and a visit date was fixed. Regretably, it would not be possible to take photographs on site for security reasons.

Preparation before the visit

Aspirin samples were prepared and purity assessed by melting point, thin layer chromatography and tests with neutral iron(III) chloride to look for starting material (2-hydroxybenzoic acid). Lessons over a number of weeks introduced students to infra-red, nmr and mass spectroscopy. Students used these techniques to identify simple molecules and to solve problems involving several spectroscopic techniques. Various chromatographic techniques (thin layer chromatography and gas chromatography) were also studied. Again students used the techniques in problem solving situations.

Activities during the visit

The students split into three small groups. There is generally little space around the equipment being seen. The groups visited in turn, an infra-red spectrometer, mass spectrometer, nmr spectrometer and high performance liquid chromatograph. Following a brief presentation on the individual equipment and discussion about the technique by a company employee, they saw one of their aspirin samples analysed. Very often, these presentations re-inforced or enhanced students knowledge and understanding of each technique. During the visit, the students met different employees, both male and female, at each location. In some cases, these employees were former students of the College and were able to describe their careers. Naturally, this provided both interest and encouragement to the visiting students.

Following the visit

Copies of all the spectra together with chromatography results were distributed so that each student had one set. After some discussion in lesson time, these were then interpreted by the students and conclusions drawn. Again these were discussed in the lesson. Students were often most encouraged when they discovered, that not only had they made aspirin and showed that it was aspirin but that it was also in a high state of purity.

This visit has been repeated over several years. All the students involved have been preparing for national exams. Where the focus was for a particular module concentrating on analytical techniques, the visit often led to significantly improved examination results for this module for many students.

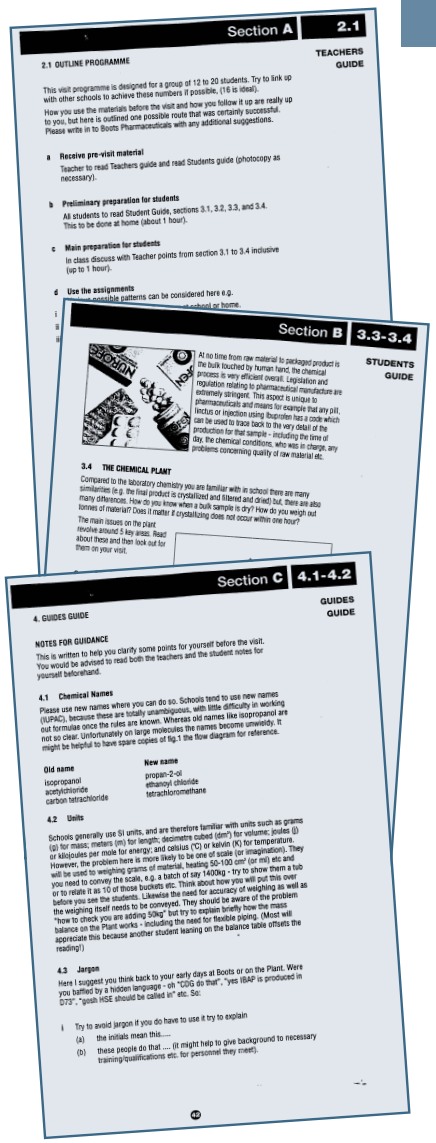
Visit 3.3

Age group:	17-18 years
School:	The Trinity School, Nottingham
Teacher(s):	John Dexter
No. of pupils on visit:	12 to 20 (16 ideal)
Length of visit:	3 hours
Overall time:	2 weeks
Company visited:	Boots Pharmaceuticals
Focus of visit:	Ibuprofen manufacture
Curriculum links:	Organic synthesis and chemical manufacture
Support materials	Salters Advanced Chemistry Chemical Storylines(8) and student Activity sheet from Activity and Assessment pack(9).

Initial Company Response

There was considerable enthusiasm and commitment from both company personnel and the teachers. This visit was set up in 1991 by John Dexter, whose students made the first visit. Following a two day teacher placement at the company's site, he prepared detailed visit guides for teachers, students and company personnel. The two days were spent looking for interesting ideas and producing a flow chart to plan the guide contents. On completion, the guides were checked for accuracy and security by company personnel. Sample pages from these guides follow this report on the visit. Since then, several other schools used the materials that John had prepared to experience the same visit. Visits by Trinity and other schools continued until 1997 when they were discontinued as the plant was run down when Boots sold their pharmaceutical interests to BASF.

Visit 3.3 was, like Visit 3.1, linked to the Salters Advanced Chemistry course. The significant difference being that the teacher who set this up produced booklets to help teachers, students and company guides.



Preparation before the visit

Up to one week, depending on how much work students were set on solving problems from the student guide. These problems were of the type that a Boots manager might have to solve. Following this work, the students had a number of questions and ideas about ibuprofen manufacture to raise on the visit.

Activities during the visit

After an introduction and a briefing on safety, the students were divided into groups of up to eight.

They visited the manufacturing areas where the saw the pilot plant, control room and production plant. Next they rejoined the other groups for refreshments and a video (20 minutes) on the chemical industry. Finally, an opportunity was provided for a discussion and to ask further questions.

Following the visit

In 1991, presentations were made by the students to other students, science teachers, governors and other invited guests. Each student presented a poster and talked for 2-3 minutes on an aspect of the visit. The student, teacher and company personnel guides were reviewed, revised and reprinted ready for next year and use by other schools and the company.

In 1992, a giant mural was produced in which each student concentrated on a different part of the plant.

In 1993, each student wrote about a page on one aspect of the visit. This page was incorporated in a booklet covering the entire visit. All students and the company received a copy of this booklet. They also made a video in which students represented safety officers, research chemists or accountant etc. interviewing each other, or simply giving a two minute presentation with a simple demonstration on a part of the visit.

Feedback was provided to the company from student questionnaires. Teachers involved provided written feedback through letters of thanks. Later, the students examination result, together with their University or other destinations on leaving the school, were sent to the company.

Visit 3.4

Age group:	17 years
School:	Masarykova Stredni Skola Chemicka, Prague
Teacher(s):	Jana Dudrova
No. of pupils on visit:	10
Length of visit:	Several visits were made to MITAS. Length of individual visits not recorded
Overall time:	Three months, visits were made in the students free time
Companies visited:	MITAS tyre plant and KAUCUK SBR plant
Business:	Tyre production (MITAS) and styrene butadiene rubber production (KAUCUK)
Focus of visit:	Chemistry of rubber and the processing of rubber waste
Curriculum links:	Chemistry, physics.

The visits were part of a large project, for which the school won a third prize in the 1997 CEFIC Science Award. During the project, students also visited two companies involved in the collection of reprocessing of used tyres and the Czech Institute of Ecology. They became acutely aware of the relationship between the manufacture of consumer products followed by the build up of waste when they are of no further use. This gave them the inspiration for their project - the chemistry of rubber production and the methods for processing rubber waste.

Initial Company Response

At both the MITAS tyre plant and KAUCAK SBR plant, the students met former students from their school. These former students were very forthcoming and helpful in providing information, much of which would have been hard to find in text books. The content of the students' report suggests that not only these former students but also other company personnel must have contributed a great deal to the experience of the visitors. No other information is recorded in their report about how the companies responded initially and what they thought after the visits.

Activities during the visits

At the MITAS tyre plant, the students investigated the history of the company as well as the modern production processes. They learnt a great deal about the origin and chemistry of natural rubber and the chemistry of synthetic rubbers. They also found out about the different components, in addition to rubber, in mixtures for tyre manufacture. They visited the compounding plant to see the preparation of the various mixtures as well as the vulcanisation process. Their report explains a good deal of the underlying science that they met. A visit to the tyre plant laboratories enabled them to see the types of test undertaken. They were also able to use equipment for determining the time needed for curing a particular rubber mixture. In the laboratory of analytical chemistry, they determined the sulphur content of rubber. The method involved combustion of the rubber followed by oxidation of the sulphur dioxide produced using hydrogen peroxide. The sulphuric acid formed was titrated against standardised sodium hydroxide.

Visit 3.4 describes several visits made by a group of Czech students as part of a lengthy project to study the production and recycling of tyres. The support from local companies enabled the students to produce a well researched report with a strong scientific approach that generated evident enthusiasm for chemistry.

At the KAUCEK SBR plant they became acquainted in considerable detail with the various parts with the process. They fully described the chemistry of the process in their project report. As with the type plant, they clearly learnt a great deal. They were particularly concerned to learn about what the company was doing to protect the environment.

The measures taken included:

- lowering the salinity of waste water;
- use of antioxidants to replace those which are carcinogenic and do not give rise to the formation of nitrosoamines;
- substantial reduction of styrene were lost to the air. Now the air from the dryer is mixed with natural gas and then subject to catalytic combustion.

The students wrote "We became convinced that the chemical industry need not be environmentally harmful. Of course, every measure taken for environmental protection results in higher costs. But - cleaner air and water are well worth it, aren't they?"

Following these visits, the students investigated various possibilities for using worn-out tyres at the Czech Institute for Ecology. They divided the possibilities into five categories: retreading, reclaiming; use as fuel; chemical processing and mechanical/physical processing. As with their other studies, they produced detailed reports for each of these areas.

In the last part of their study, the students looked at the economic aspects of tyre production and recycling of worn tyres.

Following the visits

The students wrote "We learnt how to search for essential information, how to make contact with personnel in the production plant and enterprises, and, last but not least, how to cooperate mutually." They also developed their information technology skills.

They planned a presentation of the project in their school to which they invited company and education authority representatives, their parents and other students. They wrote "presenting our results will give us the opportunity to popularise chemistry and to talk on the particular topic to a large audience."

Their report finishes:
"Most of us will probably decide to study chemistry at university, and some may specialise in the chemistry of polymers. We took inspiration from the fact that we saw former students of our school working in responsible positions in the various enterprises."

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Student comments recorded from two schools after a visit:

"I enjoyed finding out how different the chemical industry is compared to chemistry in the lab at school."

"Inspiring, if a little short, the staff were very pleasant and helpful, and preparing a follow up presentation, provided an interesting conclusion."

"What stuck in my mind was the actual size of the plant and scale of chemicals used. I would say its an opportunity not to be missed by any A-Level student."

"I wanted to work in Drug research and development eventually, and this made me even more sure."