Who is this handbook for?

- This handbook offers the essential information for devising science outreach activities and practical advice that each user can adapt to fit the situation.

- This handbook caters for any person who wishes to organize events for public understanding of science and technology: researchers, engineers, technicians, teachers, students, journalists, cultural activity mediators, who have little or no experience in such projects.

- This handbook has been designed especially to assist project initiators in the countries of Africa taking part in the programme Promotion de la Culture scientifique et technique run by the Institut de Recherche pour le Développement (IRD) at the request of the French Ministry of Foreign and European Affairs.

Find our other guides for public understanding of science on the Web site: www.latitudesciences.ird.fr
Contents

Science outreach activities
7 Public understanding of science
9 What is a science outreach activity?
11 What are science educators for?
13 What qualities for disseminating science?

The basics of science outreach activities
17 Pride of place to the scientific method
19 Know your public
21 Choose the right words and images
23 Launch questions and prompt questioning
25 Hands-on participants

Choose your tools
29 A workshop
31 A stand
33 A meeting with scientists
35 A field excursion
37 A guided tour
39 An interactive exhibition
41 Instruments and materials
43 Objects and documents
45 Science chests and games

Implement a science outreach activity
Preparation
48 Design your activity
49 Organize it
50 Set it up
51 Practise, practise
Now for the event
52 Greet the public
53 Run an interactive session
Assessment
54 Evaluate the event
Science outreach activities
Public understanding of science
What is it?

It is all the scientific and technological knowledge acquired and used by a person, which enables him or her to understand the environment, act in everyday life and think about the major issues of the future.

Who for?

Understanding of science and technology: a concern exclusively for research scientists, engineers and technicians? Not at all!

The sciences and technology play a crucial role in our everyday lives (health, food, environment, transport, communications). Understanding them so as to make better use of them is an issue for everybody!
What is a science outreach activity?
It is a popularization programme aiming to help a non-informed public discover, gain awareness of and understand science and technology.

It addresses the general public, different sections of society: children, teenagers, men, women, school educated, illiterate.

And it can come to life in a range of places: schools, primary or secondary, universities, leisure centres, museums, research laboratories, technical centres, local public halls, public squares, natural sites.
What are science educators for?
Challenge and objective:

Scientific and technological knowledge is complex. It is in constant evolution and often remains inaccessible for most people. Science educators are mediators between the world of science and the general public and are there to make access easier.

The science educator’s role:

- creating understanding of science and technology through exhibitions, visits or opportunities to meet scientists;
- presenting them for discussion in science cafés, lectures or round-tables;
- introducing people to the scientific method (observation, experimentation, analysis) by means of workshops, clubs or field excursions.
What qualities for disseminating science?
A rigorous approach and a strong aptitude for analysis to acquire the knowledge and a good command of scientific methods.

An aptitude for communication for capturing the public’s attention.

A good listening ability to adapt to the public, meet their interests, arouse their ideas.

A facility for explaining to make complex information easy to understand.

A sense of organization for planning and carrying through group activities.

And: a generous dose of creativity! for designing appealing activities.
To open up access to scientific knowledge, the science educator does not merely simplify the information. He creates a situation where the public can perform the same procedures as scientists so everyone can understand and use the knowledge themselves.
The basics of science outreach activities
Pride of place to the scientific method
The scientific method is a key process for understanding the world around us. Based on a rigorous logical approach, it comprises varied activities to build up and test knowledge.

Introducing the public to the scientific method means:

- Offering people a programme of activities where they can:
  - **observe**: describe, compare, classify;
  - **collect information**: find documentation, pose questions, measure;
  - **do experiments**: make hypotheses, build a protocol, do tests;
  - **analyse**: interpret, summarize, draw conclusions;
  - **call into question**: compare and contrast ideas, check data, discuss.

- Giving people the tools to approach a subject in a reasoned objective way and acquire autonomy to build up their knowledge.
Know your public
Before introducing a scientific concept to the public, assess everyone’s level of knowledge and the way they think.

This will help you:

• identify what makes scientific information difficult to understand;
• find the most convincing arguments and the best suited activities;
• adjust the course of the event to the participants’ progress.

How?

• Ask questions about the way an instrument works, for instance: How does a sun dial work?
• Get people to draw or comment on a diagram, for example: A bicycle mechanism.
• Stimulate the audience to give explanations of phenomena, for example: Why does the moon appear different from one night to another?
• Ask people to describe an experiment, for example: What happens when a lighted candle is covered by a jar?
Choose the right words and images
Bringing complex scientific information within everyone’s grasp without distorting the meaning is difficult, but stimulating!

**Mind your language:**

- use words that everybody can understand;
- choose simple but precise expressions rather than complex scientific terms and symbols;
- give brief, concrete and amusing explanations which create the desire to understand rather than long accounts that are overwhelming, intimidating – and boring!
- put forward examples, comparisons and pictures the public can relate to;
- formulate your words in different ways so that everyone understands!

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**From the known to the unknown**

- The scientific process founds itself on the known to explore the unknown.

So approach your subject starting from situations, images and metaphors from everyday life to make things easier to understand!
Launch questions and prompt questioning
Challenging with questions is a good way to help the public immerse themselves in the scientific process.

Put a question in the right way and you can arouse curiosity, make people think, encourage them to make hypotheses. A way of attracting replies and opening dialogue.

Stimulate questioning from the audience and help participants use logic to find the answers.

Questions for:

- **Attracting attention:** What happens when...? What do you see? What have you noticed?
- **Inspiring people to observe and measure:** How much? What size?
- **Suggesting comparisons:** What is the difference between...? Which is the most...?
- **Urging the public to experiment:** How do you arrive at...? Can you find a way to...?
- **Stimulating thought:** What has happened? What can we do? Can you explain...?
- **Encouraging a critical approach:** What do you think of...? Do you agree...? In your opinion...?
Hands-on participants
Acquiring scientific knowledge does not mean passively receiving information, but understanding, using and discussing it!

- Offer activities in which participants can **practise science and technology hands-on**:  
  - give out instruments to operate,  
  - make equipment available for experiments,  
  - propose surveys,  
  - organize team games,  
  - prompt contributions to discussions etc.

- Take account of participants’ suggestions. **Motivate and guide them – without doing things for them!**

  This active approach leads people to take initiatives. It develops confidence, brings the pleasure of understanding, encourages participants to build up their knowledge themselves and exchange ideas.
A successful science outreach activity is not just a matter of means. First you must find the activity best adapted to your public and to the objective while judging its limits and strengths.

The activity will draw from the tools which inspire the public’s curiosity and encourage people to engage in a scientific process. If some tools are expensive, borrow them or make them yourself. Gradually those will make up the supporting equipment for your campaigns.
Choose your tools
A workshop
**Description**

- A workshop introduces people to the scientific process through activities of discovery or an in-depth study of a subject. E.g.: *an association of amateur astronomers organizes monthly workshops on telescope observation of the sky, for the general public.*
- The club is a form of workshop which brings together the same group of participants for regular sessions around a defined subject and the realization of a project.

**The Science Educator’s Role**

- Implementing a programme of activities.
- Showing the scientific method in action.
- Creating cohesion in the group of participants.

**Duration**

- 1h30 on average, either occasional, regular (weekly for 1 year) or organized as a short course (2 to 5 days).

**Public**

- All publics. Well suited for young people.

**Preparation**

- In cooperation with a scientific advisor, devise a coherent schedule of activities. Arrange for the necessary equipment and means.

**Action**

- Various activities can be carried out and combined during the sessions: games, discussions, experiments, construction, observation, reference searches, surveys, or public presentation of an accomplished project.

**Caution**

- **The advice of a specialist in the chosen field is vital for the success of the workshop.**
- **Allow 1 educator for a maximum of 15 participants to ensure that the workshop runs effectively.**
| **Description** | A stand at an event for the general public (like a forum, science festival, trade fair) can offer awareness-raising activities on a scientific subject. E.g.: a research institute could display water-purification technology. |
| **The science educator’s role** | Offering visitors exciting activities inspired by the stand’s chosen theme. |
| **Duration** | Variable. |
| **Public** | All categories. Some activities can target particular audiences (children, teenagers, adults). |
| **Preparation** | Design short (20 minutes maximum), straightforward, but striking activities, that participants can do with some autonomy: games, equipment operation, posters displays and exhibits.  
Set up an easily visible welcoming stand.  
Allocate the various tasks among the educators. |
| **Action** | You can either show visitors around as they arrive or make up groups to carry out the activities.  
Incite the public to have a go at the activities.  
Show you are available and willing to tell visitors all about your organization and the stand’s theme. |

**Caution**

- Use solid inexpensive objects which can be fixed in place.
- For a high volume of visitors, programme activities at fixed times and limit the number of participants at each session.
A meeting with scientists
**Description**
- In a public place (auditorium, classroom, café), one or more scientists are brought in to give a lecture or lead a discussion on their profession, their work or to lend their expertise in the chosen subject. The audience is then invited to participate. E.g.: a debate is organized in a secondary school on new information and communication technologies (NICTs).

**The Science Educator’s Role**
- Create the conditions to allow both scientists and participants to speak.
- Reformulate and summarize the ideas put forward so everyone can understand.

**Duration**
- 2 hours maximum.

**Public**
- Not really appropriate for young children.

**Preparation**
- Choose a theme anybody can understand.
- Invite 1 to 4 specialists recognized in the field covered. They must be good speakers!
- Inform yourself on the subject and prepare some relevant questions to launch the dialogue.
- Arrange the meeting area comfortably (chairs, lighting, projection equipment, sound and public address system).

**Action**
- Give a friendly introduction to the theme and the speakers.
- Set out the rules for the discussion (speaking time, need to be concise, clarity).
- After the scientists’ talks, open the discussion to the audience. Throw in 2 or 3 questions if the dialogue is slow to take off.
- Keep control over the debate! Give a summary of the exchanges to wind up the session.

**Caution**
- Do not hesitate to ask scientists to express themselves simply and clearly, to show pictures and short films.
- Deal suitably with contributions from the public that are too long or inappropriate.
A field excursion
<table>
<thead>
<tr>
<th>Description</th>
<th>• Participants go out in the field to make observations, conduct a survey or do an experiment in “natural” conditions. E.g.: plant identification, surveys among the inhabitants of a district, meteorological readings.</th>
</tr>
</thead>
</table>
| **The Science Educator’s Role** | • Organizing the outing and guide the participants at the sites visited.  
• Coordinating the group and the activities at the field sites.  
• Paying particular attention to participants’ safety. |
| **Duration** | • Variable (1/2 to 1 day). |
| **Public** | • Any public. |
| **Preparation** | • Do reconnaissance and establish the limits of the areas to visit.  
• Define in advance the protocol of the field studies to be carried out.  
• Prepare the equipment for observation, measurement and sample collection (camera, magnifying glass, plastic bags, note pads). |
| **Action** | • Announce the instructions on safety and site protection. Give out the itinerary map.  
• Assign the roles and responsibilities of each participant (equipment, activities).  
• Explain the operations to be accomplished. |

**Caution**

- The presence of an expert is recommended.
- Arrange for enough assistants to accompany the participants, check that the weather is favourable, bring water and a first aid kit.
A guided tour
### Description
- The public are given a guided tour of a site or a scientific or technological organization and discover "science in action".
  E.g.: to a water purification plant, genetics laboratory, archaeological site, power station.

### Science Educator's Role
- Guiding the visitors in the scientists' workplace.
- Informing visitors and encouraging easy dialogue with the experts.
- Paying special attention to participants' safety.

### Duration
- 2 hours on average.

### Public
- Any public.

### Preparation
- Get to know the host organization's personnel, working places and field of activity.
- Devise an interactive 'discovery' trail with stages for observation, hands-on activities (operating machines, instruments), discussion with scientists.

### Action
- Introduce yourself and announce the specific advice for the place visited.
- Give a lively account, describing, explaining, lightened with anecdotes about the organization, the professions represented and the work that goes on.
- Present the scientists, ask them questions when visitors seem too shy to do so!
- Move regularly from one area to the next and make short breaks to keep the tour group’s attention alive.

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**Caution**

- Prepare the visit in collaboration with a representative of the host organization.
- Take care to keep track of your speaking time!
An interactive exhibition
**Description**

- Designed primarily for the general public to develop autonomy in learning, it can generate activities requiring a science mediator.  
  E.g.: for a game based on optics in an exhibition on light.

**The Science Educator’s Role**

- Ease access to information (how to find it, present it in different forms, summarize).  
- Offer complementary educational activities.  
- Indicate ways of investigating the subject further.

**Duration**

- Variable.

**Public**

- General public. Well suited to non-readers or those with reading difficulties, who prefer to listen or operate interactive displays, or are not very autonomous.

**Preparation**

- Learn thoroughly about the subject dealt with and the exhibition itself.  
- Inform yourself about the visitors (school groups, families, mixed public).  
- Choose and rehearse the interactive operations, experiments or games which bring the subject concretely to life.

**Action**

- Spot people who particularly need guidance during their visit.  
- Lay on activities, and make sure they run smoothly!  
- Give straightforward, clear explanations. Set puzzles which prompt visitors to seek and find information on the display panels.

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**Caution**

- Do not stay too long with the same people so that you can assist as many of the public as possible.

- Check that equipment is in good working order!
Instruments and materials
<table>
<thead>
<tr>
<th>WHAT?</th>
<th>FOR EXAMPLE?</th>
<th>WHAT ADVANTAGES?</th>
<th>RECOMMENDATIONS</th>
</tr>
</thead>
</table>
| **SCIENTIFIC INSTRUMENTS** | • For observation (magnifying glass, telescope), measurement (scales, GPS, voltmeter), calculation (calculator, computer)... | • Teaches how to operate precision instruments.  
• Introduces the notion of scientific rigour.  
• Shows how to do an experiment. | • Control the use of equipment.  
• Explain how to use equipment step-by-step, making participants practise the necessary operations.  
• Warn people about the fragility and dangers of certain equipment. |
| **MATERIALS AND TECHNOLOGICAL TOOLS** | • Lead wire, setsquare, tweezers, gimlets, wood, glue, electronic components... | • Teaches how to plan and produce a construction from A to Z.  
• A way of learning technical skills, practical application of theoretical knowledge.  
• Shows how to choose and maintain equipment. |
Objects and documents
<table>
<thead>
<tr>
<th><strong>What?</strong></th>
<th><strong>For example?</strong></th>
<th><strong>What advantages?</strong></th>
<th><strong>Recommendations</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objects to operate</strong></td>
<td>• Models (human body), prototypes (solar sensor), natural samples (shed snake skin, minerals), machines (engine, bicycle) etc.</td>
<td>• Arouses curiosity and dialogue, helps study a technical topic in more depth, useful as an aid for study or experiment.</td>
<td>• Choose objects that are original, familiar or complex, but not dangerous. • Compile information and prepare questions about them.</td>
</tr>
<tr>
<td><strong>Reference documents</strong></td>
<td>• Science books and articles, documentary films, sound recordings, photos, cards.</td>
<td>• For searching, comparing or checking information, study a subject in more detail or generate ideas.</td>
<td>• You need to select good quality material suitable for the target audience. Consult them before offering them for use. • Prepare questions and commentaries.</td>
</tr>
</tbody>
</table>
Science chests
and games
<table>
<thead>
<tr>
<th><strong>What?</strong></th>
<th><strong>For example?</strong></th>
<th><strong>What advantages?</strong></th>
<th><strong>Recommendations</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Science chests</strong></td>
<td>A chest contains demonstration exhibits, instruments, equipment, games, literature (books and posters) for a series of activities on a theme. E.g.: the human body, global warming.</td>
<td>Easy to transport, the chest is an aid for attracting a public having little equipment and unfamiliar with cultural centres (in rural areas), for use in travelling workshops, with interactive and fun activities.</td>
<td>Mediators need training in the use of the chest. Instruction sheets should be included to help prepare the activities. The chest contents can be supplemented with other easily available materials (paper, sand).</td>
</tr>
<tr>
<td><strong>Games</strong></td>
<td>Memory games, treasure hunts, role play, puzzles, quizzes.</td>
<td>Moments to have fun, sharpen people’s knowledge, senses and interactivity. Competition and a social atmosphere make players keen to get involved.</td>
<td>List the equipment, decide the area for playing, the timings, fix the rules (make sure they are applied!), organize teams, a trial run, announce the results and close the game.</td>
</tr>
</tbody>
</table>
You can’t just organize a science outreach event overnight. Implementation requires good command of the subject and of the basic activity-management techniques, a simple but rigorous organization and training. For some, science may be daunting, boring or off-putting but an active event creating strong interaction and inspiring the public’s involvement can be a great success.
Implement a science outreach activity
Design your activity

Make choices

Begin by defining the event’s objectives and subject, taking account of the views of people you are dealing with.

Opt for an appealing subject which arouses concrete questions drawn from everyday experience. Devise a simple interactive activity programme linked to a central theme.

Get informed and train yourself

Update your knowledge on the chosen subject and develop your associated skills, individually or as a group. To do that you can consult:

- **up-to-date, reliable, high-standard references:** encyclopaedias, scientific publications, special features produced by the media, accessible in libraries or on the Web;
- **experienced people:** experts who can check the scientific information relating to the subject, education specialists and instructors to learn good practices to adopt for mediation, colleagues so you can spot the most suitable methods for activity organizing.
There’s no better way to determine your activity programme than to **write a strategic plan**. For each action define: the objective, the time allotted, the method, equipment and the role of each educator where a team is involved.

For a worthwhile event, **aim for a maximum of 15 participants for 1 educator**. If you’re holding “meet the scientists” sessions (lectures, discussions), though, the audience can be larger.

To **give** the activity a **rhythm** and **inspire** the **participants’ interest**: Alternate different types of activity (observation, literature research, experiments) and the ways the public can get involved (individually, in teams, the whole-group).

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**Rhythms**

Bear in mind that members of the public, especially children, will find it difficult to:

- take part in a session longer than 1 hour 30 minutes or 2 hours;
- hold their attention on the same subject for more than 45 minutes;
- actively perform an operation continuously for more than 15 to 20 minutes;
- concentrate intently for more than 5 minutes.
**Preparation**

### Equipment

- **List** the equipment required.
- **Choose** equipment easy to operate, reusable, solid and safe; you must know how to use it properly.
- **Always test** that it works!
- **Have extra equipment** on standby in case of a programme change or to do experiments suggested by participants.

### Venues

- Reconnoitre **premises** and **sites** (area available, drinking water supply, tour circuit).
- Make sure conditions of **safety** and **comfort** are up to standard.
- Arrange the **area** to make communication easy.
- Facilitate access and allow for convenient use of **equipment** (storage space, electricity sockets).
Practise, practise

- For peace of mind: *keep the programme in your head!*

- **Make sure you can explain** the theme clearly and simply.

- **Memorize** an introduction, key questions and some anecdotes.

- **Anticipate** the public’s reactions to the activities you are offering.

- **Rehearse** all operations to keep everything running smoothly!

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**Speak to be heard!**

- **Your voice:** speak clearly and enthusiastically to capture the audience’s attention and make sure you are completely comprehensible.

- **Your gaze:** create contact by looking at people in the audience, without staring.
Greet the public

- In a friendly manner, get to know the participants (age, level of education, occupation, motivation) and introduce the event programme (aims, duration, available means).

- Explain the “rules of the game” for:
  - the group: punctuality, mutual respect, taking part, conviviality, cooperation;
  - the activities: take care of the equipment, sharing, keeping tidy, cleaning up;
  - safety: prevent possible risks associated with the place and the equipment.

Being organized and rigorous is all part of the scientific process!

- Handle the group tactfully: define the participants’ roles in the activities, call upon each person’s experience, while maintaining a good humoured atmosphere...

The right to be wrong

- An educator, like the public, cannot know everything and may be wrong!

  If a doubt arises in the middle of explaining a scientific concept, if an operation fails or a hypothesis is not validated: discuss the problem!

- We can learn by our mistakes. Analysing an error is part of the scientific process.
Run an interactive session

- To start with, capture the public’s attention, set out the scientific questions involved, encourage people to express their ideas on the subject.
  - Set them a puzzle, e.g.: can we grow plants upside-down?
  - Invite comments about an object, e.g.: a water filter.
  - Create a surprise, e.g.: a spectacular chemical reaction.

- Next, get your activity programme going, leading all to practise the scientific method hands-on, mobilizing their knowledge and experience.
  - Bring participants to handle instruments and equipment, e.g.: a microscope.
  - Suggest experiments to explain a phenomenon, e.g.: evaporation of water.
  - Get people to make devices which explain a technological principle or a mechanism, e.g.: by assembling an electrical circuit.

- To finish off: give a review of the activities with the group, and highlight the positive value of the public’s efforts and the results obtained. Open up new horizons!
An overview report to ensure initial objectives have been met.

**Who for, why?**

- **The science mediation team:** to improve practices and devise new projects.
- **The participants:** to enable them to judge the stage they are at in their learning process.
- **The partners, client bodies, sponsors:** report on the success of the project.

**When?**

- **In mid-programme** to examine progress and change course if necessary.
- **Very soon after the event** or later for a retrospective judgment on the outreach objectives achieved and objectives left unfulfilled.
How?

• **Clearly define what you wish to evaluate:** activity programme, public attendance figures, awareness and understanding gained by the participants.

• **List the strengths and weaknesses,** their causes and consequences.

• **Ask the opinions and advice of the participants, your team,** or of someone from outside the organization, to enrich the input for the evaluation.

The report gives ideas for a follow-up!
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