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groups, forty minutes watching a film on pond life does not compare with spending forty minutes around the pond with a net. We still make use of these visual aids, but only in special circumstances. We have tried to learn by our mistakes and the learning curve is still climbing. The 'Kiss Principle' is a method we have tried to follow especially with young children. If you sneak up on them and introduce some scientific concepts and ideas, with an element of fun, when they are not looking they seem to retain some of the knowledge. An example of this can be seen during the 'mini-beast' safaris.

Originally we supplied every child with either a sweep net or pooter – chaos reigned with little success. The simple concept we were trying to get across was the diversity of organisms. However, we didn't achieve this. Gradually another method evolved where we gave every child a plastic specimen bottle with the instructions to use their eyes and collect different types of invertebrates. At this stage very little information on individual species was provided. At the end of the field trip the children construct their own key using various physical characteristics. To date this has been very successful, with many repeat visits for follow up work. It also relieves pressure on the ponds, which are booked solid from May to September.

Building up a Network and Maintaining Links

Initially the Natural History Centre operated in isolation. However, it was soon apparent that we could offer a more effective service by building up links and liaising with departments within Burnley Borough Council and with schools and community groups.

We have organised INSET Days for teachers, and we have built up links with teacher training colleges. We are also in the process of organising small working groups of enthusiastic local teachers for educational projects, and to provide a forum for discussion and feedback. We wanted to encourage different teachers, different sections of the planning department, and different voluntary organisations, to make contact, thereby creating an awareness of the opportunities that are around in the environmental field. Another function of these 'cluster groups' of teachers is to pool resources and gain access to a variety of grant funding bodies.

Access to grant aid and maintaining a high profile within the environmental education field is fundamental. Several organisations are based in the Centre. The Young Ornithologists' Club, which is the junior branch of the Royal Society for the Protection of Birds, meets regularly in the Centre; in fact, the staff are actually involved. Since the YOC was formed in 1990 we have raised over £5,000 in grants from a variety of sources including English Nature, Shell UK, and the Urban Programme, to purchase textbooks, binoculars, telescopes, recording equipment, and for environmental projects. These projects include habitat creation, tree planting, creating ponds, etc. The RSPB, which is the parent organisation, also believes it is essential that educational policies ensure that all young people receive a sound environmental education. The RSPB is also very active in producing resources and providing educationalists with training. For instance, they distribute free of charge a newsletter to every school in the country. They have also produced a twenty four page document called the 'Vital Link' which focuses on environmental education.

Practical Environmental Education

There are a number of activities which the Natural History Centre uses to provide a practical hands on experience to create a better environment. These include:

- tree planting or raising trees from seeds
- provide bird feeding stations to attract and examine bird life
- flower planting
- creation of wildlife gardens
- making bat and bird boxes
- creating ponds
- clearing ditches
- litter drives and recycling bins for aluminium cans and newspaper

A lot of these activities have reduced vandalism and imparted a sense of ownership. Towneley Park, which is to the south east of the town centre, is on the urban fringe. Consequently, public pressure of over 1,000,000 visitors per annum does lead to incidents of mindless destruction. Children who take part in habitat creation and practical environmental education feel a sense of ownership and involvement.

Summary

We are in a fairly unique situation with a purpose built educational facility with a simple 'mission statement':

To interpret the fauna and flora of Burnley and the surrounding area for the educational benefit of the local community.

We have the back up and support of a museum service with substantial natural science collections, and a very sympathetic and supportive curator. The challenge in education and planning is to ensure we win the 'hearts and minds' of local people especially children, who fortunately are now more environmentally conscious than ever before, and schools are going to demand more environmental education.

So, to summarise, we must be positive. We should recognise what is already happening in schools, encourage good practice, spread the new around, and promote environmental education as a cross curricular activity which can be fun and stimulating.

Reading List

Royal Society for the Protection of Birds (1991) *Environmental Education on Integrated Approach,* Proceedings of a One Day Conference held in Manchester on 28 November 1991.

National Curriculum Council (1990) *Curriculum Guidance 7: Environmental Education.*

National Curriculum Council (1989) *Curriculum Guidance 3: The Whole Curriculum.*

DESIGNING ACTIVITY SHEETS FOR NATURAL HISTORY COLLECTIONS

Bill Clarke and Carol Levick, Education Officers, Natural History Museum, London, SW7 5BD

The Education team at The Natural History Museum in London use activity sheets to help visitors interpret the Museum's natural history and geological exhibitions. In this article you can find out exactly what we mean by 'an activity sheet', why we use activity sheets as a means of communication, how we structure the sheets and how we develop new sheets.

What are our activity sheets?

Our activity sheets are booklets of words and pictures, from 4 to 8 pages long and either A4 or A5 in format. The words are written to direct users to make close observations of particular specimens or displays. The pictures may guide them to find certain objects, or help to focus their observations.

Each activity sheet covers a sequence of 'teaching points' – specified objectives that we wish to communicate. The teaching points are linked to make a 'storyline'. Each activity asks the sheet's user to make some observations. Then, the user has to process (think about) the observation. The user also has space on the sheet to record what they have found out.

Why do we use activity sheets?

The Natural History Museum in London has a wide range of exhibitions covering many aspects of life and earth sciences. Themes as diverse as gemstones, dinosaurs, marine conservation and British woodland are explored. Yet all the exhibitions have something in common; they have been designed for the Museum's typical visitor, a 'committed learner' with an adult reading age and an adult understanding of concepts.

Clearly, many visitors do not fit this description, in particular the 200,000 children who visit the Museum each year in organized school groups. Almost 90% of these students do not have an adult reading age. The children benefit from support in interpreting the

specimens on display and learning from the exhibitions. They and their teachers have particular needs which must be met by the visit, and so require help to focus on and make sense of the exhibits.

We find activity sheets to be an effective way of providing support for such large numbers of visitors. The activity sheets can take account of the difference in reading age and conceptual understanding between the sheet's user and the exhibition's intended audience. Each activity sheet is designed to 'bridge the gap' for a particular target audience, and therefore make learning in the Museum more stimulating and enjoyable.

What do we think makes an appropriate activity sheet?

An activity sheet should enhance both the learning experience and enjoyment that the Museum's exhibitions can offer. Our activity sheets ...

* have clearly defined aims and objectives – 'teaching points'
* have a 'storyline' – a sequence of teaching points that progresses clearly from one point to the next
* emphasize direct observation of the **objects** on display, not the text
* use a variety of methods for collecting information (and using senses other than sight where possible)
* invite a range of cognitive responses
* use a variety of methods of recording information
* require observation in the exhibitions for their completion
* have a user-friendly, lively feel
* have an interesting and attractive layout.

How do we make our activity sheets lively, interesting and accessible?

We use a variety of techniques to ensure that our sheets are accessible to the widest possible audience, and to ensure that they maximize the possibilities for learning. Variety is the key. We aim to engage the visitor in different kinds of activities and use different methods to make the activities work.

Observing, thinking and recording

For each exhibit involved in the activity sheet, we ask the user to make an observation (to look, listen, touch). We might even ask them to smell or taste if these are ever appropriate!

We then ask them to do something with that observation, to carry out some kind of cognitive processing. For example, they might compare or contrast, deduce, calculate, describe or give an opinion.

The activity sheet then gives an opportunity to record some information, either as part of the observation or part of the thinking process. A variety of recording techniques are used – writing, sketching, shading, ticking, circling or matching/linking. The structure of the sheet gives visual cues for how much free writing is needed. Most of our sheets require very little free text response. We want to emphasize their observation and thinking rather than their writing and spelling skills.

Types of questions

'Low order' questions need a simple, mechanical response. These can introduce an idea, give confidence by confirming that the user can cope with the activity sheet, or consolidate what they have learned. 'Middle order' questions involve some thought and deduction. 'High order' questions are open-ended and encourage the user to give opinions. These may have many acceptable answers. This hierarchy allows teachers to assess a range of responses to evaluate understanding of key ideas.

For example, imagine a student observing a polar bear in a glass case, with a large photograph of its icy environment in the background. A low order question might ask the student *What colour is the bear?* , a simple observation requiring only a mechanical response. A middle order question might ask *Is the bear well camouflaged in its environment?*, requiring the student to compare the bear's fur to the dominant colour of the photo and make a deduction. A high order question might ask the student *How does the bear's colour help it to survive in the Arctic,* requiring the student to relate the concept of camouflage to hunting and hiding strategies. Each type of question is equally valid in assisting students to learn from observation.

Text

Since the text used in our exhibitions is geared toward an adult audience, an activity sheet for students under 14 should rarely, if ever, require them to read the text on display. The text on the activity sheet should be appropriate for the age of the defined audience. The text is made as simple as possible to deliver the concept. We have chosen a font called *Syntax*, with modified 'a's and 'g's, which is clear and easy to read.

Illustrations

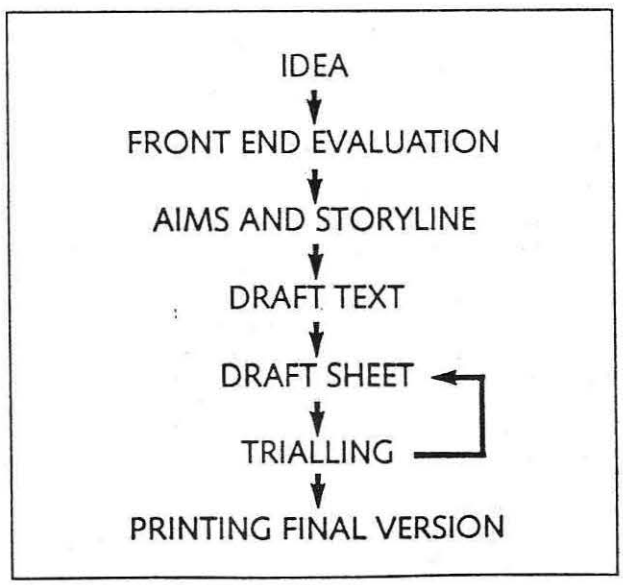
Pictures have several uses. They can provide visual cues for finding an exhibit (a potential problem in a large, busy exhibition). Others form part of an activity – and must be completed by the user, or compared to the actual object. They can involve matching or contrasting exercises. The drawings on our sheets do not provide a substitute for observing the exhibits themselves. Although our pictures are not used simply to 'pretty' the page, the illustrations used to support the activities will tend to add interest value to the sheets.

Pictograms

We include 'pictograms' on the activity sheets to help younger users to understand the nature of each activity. A simple human character is shown 'doing' whatever the user is asked to do. For example, the character may be looking, reading or matching. In addition to clarifying each task, the pictograms also provide distinct visual cues for the start and end of each activity on the sheet. Pictograms are currently being used on all sheets for students under 14.

Procedure for developing an activity sheet

This flow chart shows the stages followed in the development of our activity sheets.



Initial ideas and front end evaluation

The initial idea for an activity sheet could come from talking to visitors, from teachers' suggestions or from the National Curriculum. Our 'front end' evaluation (the information we collect before starting a new activity sheet) allows us to assess whether the proposed idea would be worth pursuing. The education officers will talk to teachers, members of the public and especially children to find out what the students do and do not understand. In this way we become aware of common difficulties or misconceptions. We also

try to find out which topics are the most interesting or useful to the visitors. From this investigation we will agree the teaching points for the sheet or series of sheets.

We define the aims and write a storyline

The originators of the sheet will define the target audience and the teaching points. They will then link these points in a coherent order to form a 'storyline'. They will consider the appropriateness of the content for the target audience, the number of aims, the logical order of the teaching points and the route to be followed in the galleries.

The originators then circulate the aims and storyline to the whole education team and invite comments. This will identify any obvious problems with the sequence. Since this early phase has required only minimal investment of the originators' time, it is easy for them to remain open minded and to reject any unworkable teaching points. In smaller museums, anybody working alone to design sheets could benefit from the view of a colleague or local teachers before progressing further.

We prepare a draft sheet

Once the storyline is agreed, we write a draft of questions and activities. The originators will take care that the language is appropriate, that the activities involve learning from objects, that a range of questioning levels and recording techniques are offered and that the layout is clear. Rough sketches and drawings are included. The originators will bear in mind the time expected to complete the sheet, which should range from 20 minutes for a Key Stage 1 pupil to 50 minutes for a Sixth form student.

The draft sheet will be circulated amongst the education team, and they will try it out in the exhibitions. Then, we hold a progress meeting to discuss problems with locating exhibits, following instructions, answering questions or with the layout of the pages. This meeting is part of the sheet's formative (early stage) evaluation. The purpose of the meeting is solely to **identify** problems. The **solutions** to these problems will be found later by the sheet's originators.

We try the sheet with the target audience

After the progress meeting, the originator/s will refine the draft sheet and produce a final version to try out with representatives of the target audience. This trialling extends our formative evaluation, and is the real test for any sheet.

The originator will trial the sheet with several groups. We aim to trial with at least six groups (6-10 students at a time) with varying abilities and background knowledge of the topic being explored. We emphasize to the students that it is the sheet that is being tested, and not themselves. This is an important point to make, especially with younger volunteers.

We observe their behaviour and conversations as they find the exhibits, tackle the activities and record their findings. We time how long it takes to complete the activities. We can also see how much assistance, if any, they need from their accompanying adults.

If at least 80% of the target audience can successfully complete 80% of the activities on the sheet without help, then we feel it is appropriate for the target group. The activities should boost confidence and invite the children to succeed, but also provide some interesting challenges. This balance is essential in achieving a worthwhile activity sheet. A sheet which is completed with a 100% success rate by all students may indicate a lack of challenge or stimulation.

We also trial the sheet with students a little younger and older than the focal age range to assess the sheet's full usefulness. In this way we can have greater confidence in recommending the sheet to teachers of different age groups. We do not print a 'suitable age range' on the sheets, but leave the final decision to the children's educators.

Further refinements are made after each trial until the originator is happy that the sheet will 'work'. A final trial forms the summative evaluation (information collected after the completion of the sheet's design). When any final problems have been sorted, the activity sheet is ready to be printed!

Who is involved in writing our activity sheets?

Early procedures involved the whole education team and representatives from the Graphics and Exhibition Design teams. This large group meant that meetings were often frustratingly slow. We now design activity sheets working in pairs (sheet originators), working under the direction of an activity sheet coordinator, and feeding ideas to the whole team at key consultation points. This has proved far more productive.

Some concluding remarks

In these notes we have not attempted to support all of the reasons for following certain procedures with specific references to research. It has not been not the intention of this paper to compare the success of 'distance-learning' techniques with other teaching strategies. However, we have included an annotated bibliography for readers wishing to explore further a full range of considerations when developing activity sheets.

The Natural History Museum's education officers produced about 20 new activity sheets in 1992-93, for students ranging in age from 5 to 18 years. We found that the methods of producing sheets developed with experience, and later sheets progressed more smoothly, as we learned from our earlier efforts.

When someone is designing activity sheets, each natural history collection presents its own unique learning opportunities and difficulties of interpretation. Therefore, this description of the way in which The Natural History Museum's Education team works is not intended to be prescriptive. However, we hope that readers will find a lot of common ground and be able to benefit from our learning experience.

Some considerations for designing activity sheets

It can be useful to use a check-list when designing your first few activity sheets. Although many aspects are not complicated, it is possible to overlook a point when there are so many to consider. The following list could provide a basis for checking.

Practical points

* Are the exhibits easy to find?
* Are the exhibits easy to see (suitable height for child and well lit)?
* Is it appropriate to touch the object (would the exhibit suffer wear or could there be any irritation to the user)?

Educational points (general)

* Will you provide teaching points to help interpret a display or can you provide objects to help students learn the teaching points?
* Can the students explore the exhibits by visual observation only or by touching and listening too?
* What prior knowledge or skills do you expect of the students?
* Do you want the activity sheet to provide the basis for follow-up work after a visit to the exhibition / handling of objects?

Educational points (activity sheet)

* Have you clearly identified your target audience?
* Have you defined your teaching points?
* Does the order of the teaching points seem sensible (are the teaching points progressive and 'connected')?
* Have you given clear instructions for finding the exhibits?
* Have you made each task clear for the user (observe – cognitive process – record)?
* Is there an interesting range of observations to be made?
* Is there variety in the cognitive skills used (measuring, comparing or contrasting, deduction, interpolation etc.)?
* Have you provided a variety of techniques for the user to record the findings of their observations and thoughts?
* Is there a selection of types of question (mechanical/closed – deductive – open/higher order)?
* Is the language level appropriate for the target audience?
* Are the skills involved appropriate?
* Will you use illustrations to locate exhibits?
* Will you use illustrations as an integrated part of the activities on the sheet?

* Would pictograms (symbols) be appropriate for consolidating the tasks on the activity sheet?
* Have you provided a summary of what the user has learned?

And overall...
* Does the sheet appear interesting and attractive?
* Will the user have fun learning from the activity sheet?

The education officers at The Natural History Museum, London, have developed this structure for designing and developing activity sheets so that a very large number of young visitors can benefit fully from an extensive range of adult-oriented exhibitions. We have found the sheets to be successful and popular and hope that our experiences may prove useful to readers wishing to develop their own activity sheets.

Activity sheets: reading list

The following references provide greater in-depth analysis of the cognitive processing that occurs when people use activity sheets to help interpret exhibits. Research-based justification for questioning skills and the influence of sheets on visitors' behaviour in exhibitions are also explored.

Durbin, G. (1989) Improving Worksheets, *Journal of Education in Museums* **10** pp: 25-30. [A clear and accessible article with an emphasis on questioning techniques].

Fry, H. (1987) Worksheets as museum learning devices, *Museums Journal* **86 (4)**, pp: 219-225. [A survey of changing attitudes to worksheets with a positive tone and a helpful bibliography].

Hall, N. (1984) *Children, Materials and Interpretation. in* Hall, N. (ed) *Writing and Designing Interpretive Materials for Children*, Design for Learning and Centre for Environmental Interpretation, Manchester Polytechnic. pp: 27-35. [A thought-provoking discussion of the way that written materials help or hinder a child's interpretation of a display and a view on the role of interpretation in the learning process].

Jones, L. and Ott, R. (1983) Self-study guides for school- age students, *Museum Studies Journal* **1 (1)** [Emphasizes the value of learning from objects and focuses on types of questions. Looks at collaboration between museums and schools].

McManus, P. (1985) Worksheet-induced behaviour in the British Museum (Natural History) *Journal of Biological Education* **19 (3)** pp: 237-242. [An example of how to assess the effects of the use of activity sheets in exhibitions. The sheets referred to are no longer in use at The Natural History Museum. This research shows that some techniques used to elicit a response on activity sheets can cause problems].

Wright, A. (1984) *Writing Interpretation Materials for Children* in Hall, N. (ed) *Writing and Designing Interpretive Materials for Children*, pp: 77-88. [Design for Learning and Centre for Environmental Interpretation, Manchester Polytechnic Concentrates on cognitive processing when children interact with objects].

Other useful references to activity sheets (worksheets) can be found in the following articles...

Davis, H.B. (1980) Kids have the answers: do you have the questions? pp: 64-68 *in Instructor* **90**. [Looks at types of questions and their implications].

Durbin, G./ Morris, S./ Wilkinson S. (1990) *A Teacher's Guide to Learning from Objects*. English Heritage. ISBN 1-85074-259 6.

Durbin, G. (1989) Evaluating learning from historical objects pp 12-13 **in** Hooper-Greenhill, E. *Initiatives in Museum Education*, Department of Museum Studies, University of Leicester. ISBN 0 951005-0-3.

Grinder, A.L and McCoy, E.S (1985) *The good guide: a sourcebook for interpreters, docents and tour guides*. Ironwood Press, Arizona. ISBN 0-932541-00-3. [Looks at questioning strategies].

O'Connell, P.S (1984) Decentralizing interpretation: developing museum education with and for schools. *Roundtable Reports* **9 (1)** pp: 17-22. [Designing material in collaboration with teachers].

Reeve, J. (1981) Education in glass case museums *Journal of Education in Museums* **2** pp : 1-6. [Suggests ways of working with displays of material which cannot be handled].

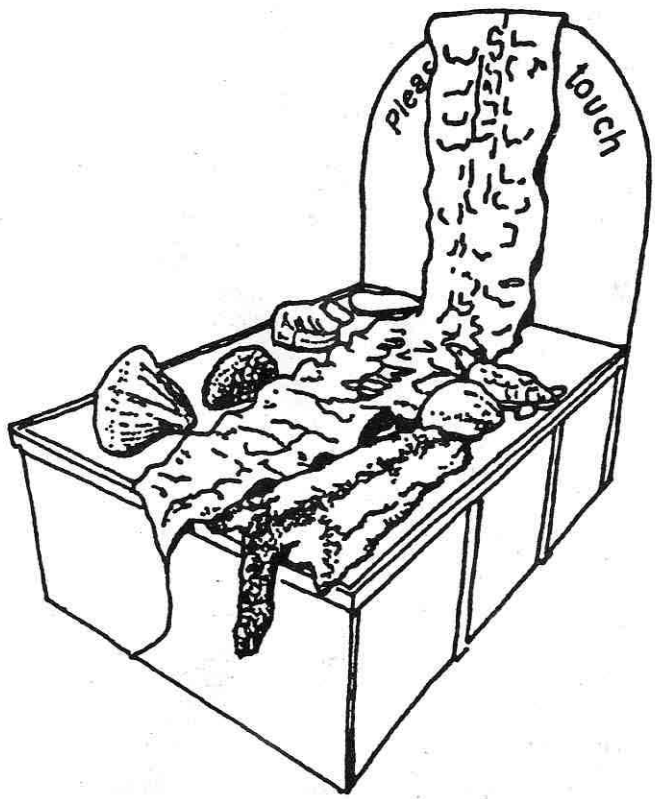
THE TRAVELLING DISCOVERY CENTRE (TDC): What we have discovered while it has travelled.

Amanda Pearson, Travelling Discovery Centre, Natural History Museum, London, SW7 5BD

The Natural History Museum's Travelling Discovery Centre (TDC) has been on the road for four years. Sponsorship from Marks and Spencer has enabled us to take it to a number of venues free of charge. These have included museums, countryside and environmental centres, and even a shopping mall.

If I were asked to identify one lesson I had learned from my journeying with it, it would be this – **never assume anything.** Bearing this in mind, let me begin by explaining what the TDC is and the service I offer.

Based on the permanent Discovery Centre at The Natural History Museum, London, the TDC aims to encourage first hand investigation of natural history. A series of hands-on activities are used; visitors can stroke a python skin, become a seashore detective, or hunt for fossils. The exhibitions philosophy is one of learning by doing...



Children aged 7-11 years can visit the centre in booked school groups during term time whilst at weekends and during holidays it is open to the general public.

The element that makes the TDC visitors experience particularly memorable is its explainers. These people have three important functions to fulfil. First, and most importantly, they are there to interact with visitors, and to enhance and extend their learning experience. Secondly they ensure the space functions smoothly (sharpened pencils, enough worksheets, correct specimens in appropriate boxes), and thirdly they can keep a keen eye out for wandering specimens!

To those of you concerned about taking your specimens out from behind their protective glass I should add that in 4 years of being on