Educational Research

Nature tables: stimulating children's interest in natural objects

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Primary school pupils in the UK today may be less familiar with natural objects, less exposed to formal natural history teaching and have less time given to school-based observation and discussion of natural objects. This study of children's responses to a 'Nature Table' of displayed natural objects was designed to assess pupils' knowledge of those objects, the sources of their knowledge and the phenomenological nature of those children's interest in items which they selected to talk about or to photograph. Children in the study were drawn from the first year of formal schooling (age 5-6) and the fifth year of formal schooling (age 9-10). Responses have been recorded and analysed using a simple systemic network. Results show that pupils are attracted most towards items with: an animate or novel nature or appearance, or for which they have some prior familiarity. Items are also attractive if they have aesthetic attributes, which display some responsiveness to the child or engage with the child's previous experience, or elicit affective feeling. The present study reveals a greater home-based, rather than school-based, source for much of this experience and suggests how the criteria for teachers selecting natural objects for learning in school might be improved.

Key words: Nature; Natural; Observation; Children; Knowledge

Introduction

This investigation explores young children's appreciation and interpretation of natural objects as presented to them on a 'Nature Table' in a school context in their first and fifth year of formal schooling (aged 5-6 and 9-10). The opportunities for first hand observations of natural objects by children are a crucial aspect of pupils' early biological education entitlement and a generator of future interest. In the English primary school there has been a decline in local out-of-school education and in formal fieldwork. Through urbanisation and a reduced freedom for children to play unsupervised, there has been a loss of opportunity for children to readily engage with natural objects and living things in their home environment. This educational need is increasingly being seen in western society as a *learning-opportunity deficit* which teachers and society should address (Nabhan and Trimble, 1994). Louv (2006) describes this as a "nature deficit disorder". There is, moreover, evidence for this increasing estrangement from formative experience of the natural world in the UK with children displaying a higher knowledge of artificial creations, like *Pokémon* characters (Balmford *et al*, 2002) than of common forms of wildlife.

However, children are also innately interested in living things. Rinsland (1946) found that in the first vocabulary of young children the largest of the 22 semantic categories was that of types of everyday animals (36 animal words out of a total of 275 everyday words). The animate-inanimate distinction is known to be a fundamental concept that emerges early in infancy and children infer much more from animals than from a range of inanimate artefacts (Gelman, 1988). This is marked in pre-school children (Heyman and Gelman, 2000) and was, in their work, demonstrated clearly by their higher ranking of those objects with 'animacy'. This attractiveness of the animate world is exploited by animatronics, robotics, game-boys and now totally realistic computer animations on screen. All of these are powerfully attractive to urbanised children deprived of real experiences of nature.

Classifying, identifying, pattern seeking and exploring are often seen as fundamental to a wider set of process skills needed by children doing science as their learning develops at lower secondary level (Key Stage 3) (Watson *et al*,1999). Are children in the preceding age group, in primary school (Key Stages 1 and 2), adequately inducted to these observation process skills? Observation is a universal activity, unconfined to science, and it is too easy to dismiss it as a very basic skill and regard 'just looking' as so trivial as to be unworthy of research. The experience of lower secondary pupils (age 12) who spend time looking at animals is formative in early science process development (Tomkins and Tunnicliffe, 2001).

The 'Nature Table' has a long history in primary schools. Classically, this was a small table to one side of the class or assembly hall upon which novel natural objects were presented to children on a regular basis through the seasons of the year. Natural history study was well enshrined in many primary children's experience over a century ago (Hoare, 1904). Amongst the teachers who grew up then was Susan Isaacs and, a generation later, she had a formative influence on primary education (Isaacs, 1932; Drummond, 2000). Isaacs identified the 'spontaneous interest' displayed by children in natural objects that they find and, as Drummond describes it, 'the parallel universe of children's imagination' that goes with such discovery learning.

Research into the 'Nature Table' of 50 years ago revealed for us some interesting facts about lost practice in the England (Tunnicliffe and Tomkins, 2006) and we now see merit in exploring children's responses to the classic 'Nature Table'.

At the same time the issue of estrangement from formative experience of the natural world might be usefully addressed. In this study the spontaneous comments of individual primary age children at a newly set up 'nature table' have been recorded by written notes taken from oral conversation with children. These responses and children's answers to a verbal questionnaire are analysed using a simple systemic network (Tomkins and Tunnicliffe, 2001; Tunnicliffe, 1995).

Research objectives

The key research objectives of this work were:

- to elicit and record responses of KS1 (age 5-6) and KS2 (age 9-10) children to a selected variety of natural objects displayed on a nature table in school.
- to identify more clearly the children's sources of existing knowledge and the patterns of observation that these children make.
- to analyse such responses to ascertain the kinds of knowledge, interest and understanding revealed.
- to help teachers improve their delivery to children of early primary science teaching and to improve awareness of the need for better primary children's experience of nature and natural objects.

The first two of these were ascertained by the short questionnaire, given orally to each pupil in turn by one or other of the authors, recording responses in note-form. The third is pursued in the analysis of these observations as described below. The fourth is a desired outcome through in-service education.

Research design and methods

Children from three non-selective state-run infant and junior schools, each with a wide pupil ability and wide socio-economic range, were chosen. It was appreciated that responses may be gender and age-related. In order to seek some clarification of children's progression, the study was conducted at two ages: the first year of formal schooling (age 5-6) and the fifth year of formal schooling (age 9-10). In all, 46 first year pupils (23 M and 23 F) and a matching number of fifth year pupils (23 M and 23 F) were interviewed. The total sampled was 92.

Thirteen standardised exhibit objects had been previously selected for these children to look at and to comment upon (Table 1). These were chosen as a range of natural objects that were likely to be encountered by children, ranging from the clearly inanimate (rocks and crystals) through 'once living' categories to the clearly animate (live plants, fungi and animals). They were thought sufficiently interesting to the children to provide them with (a) a motivated choice and (b) an ease of verbal description.

These 13 objects were arranged randomly on the top of a small table. Children were pointedly and slowly introduced to each item, but not by name, and were then allowed to look at all of them for a minute before the individual interviews in which written recording was made of the spontaneous comments from each child interviewed, using the questionnaire. The children were invited to select *three* objects upon which to comment more fully. Children's expressed knowledge, interest, affective feeling and opinions were recorded (written notes) in these one-to-one interviews.

Children were asked to say what they thought the object was, how they knew about the object, where they had, if at all, encountered such a thing before, what it was called, what else they knew about it, and why they chose the object to talk about, etc, in the first place (there were a total of 276 expressions of interest, i.e. three from each of 92 children). From the children's choices and the notes taken by the researchers of what the children said, the subsequent analysis was made.

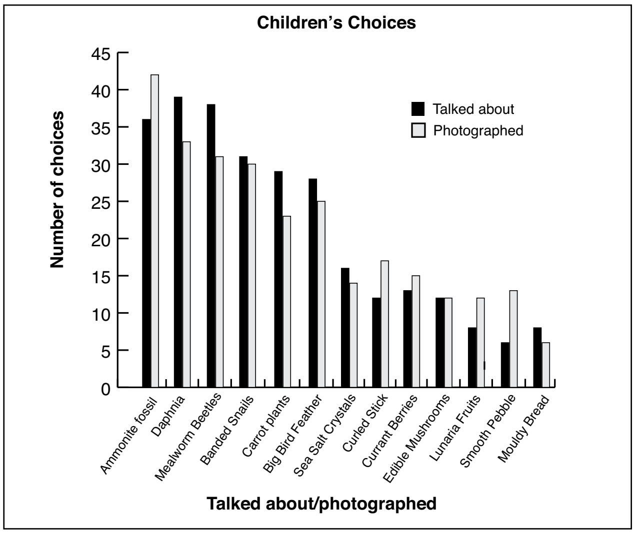
After answering the questions, each child was invited to take a photograph of any *three* objects (out of the full 13) that interested them and which "they would like to remember by keeping the photograph". The items were not necessarily the same as the earlier selection. Children were now asked to give reasons why they selected these three objects to remember (again, 276 expressions of interest for photographing).

A simple analysis was made of the questionnaire responses; the choices, the degree of knowledge or categoric reason given for the interest expressed, and the differences between those

Table 1. The Nature Table Objects

Criterion for inclusion	Description of the Object
Things clearly inanimate	Smoothly worn sea shore pebble Large white crystals of sea salt
Once-living plants	A seemingly twisted hazel (*Corylus*) stick entwined by honeysuckle (*Lonicera*) A flowering head of dried fruits of *Lunaria*
Once-living animals	Coloured banded-snail shells (*Cepea*) of varied colour Primary flight feather from a large bird (eagle or goose) An ammonite fossil (8cm diameter) exposed in a rock
Living plants	Several freshly pulled carrots with full root and leafy tops Either red *Viburnum* berries or redcurrant or blackcurrant (*Ribes*) berries
Fungi/microbe	Mushroom (*Agaricus*. sp) A piece of very mouldy bread and cheese, inside a child's transparent lunch box
Living animals	A jar of pond water with living waterfleas, *Daphnia magna* A covered tray of meal worm (*Tenebrio*) beetles and larvae

Figure 1.



objects selected for reporting and for photography. The systemic network employed by the authors was similar to that employed previously (Tunnicliffe, 1995; Tomkins and Tunnicliffe, 2001) and was applied to the choices made. Assertion of significant quantitative difference between data is made only where the total number in a sample was >50, where cell categories were >5 and, for 1 df, were χ^2 was above the critical value of 3.84 at the 5% level. Many of the qualititative responses are below this level but are considered nonetheless noteworthy and indicative.

Results

Preliminary analysis of children's choices revealed no difficulty in the performance of the selection task itself. Each of the objects was selected by at least some children to rank in their 'top three' to talk about. Equally easily, children selected three objects to photograph (that they wished to remember). The actual choices for all the children are shown in the ranked bar chart, Figure 1 and the concordance of choice between 'talked about' and 'photographed' is expressed in Table 2.

For photographing, most children selected at least one different object from those talked about. With respect to age, for both age groups of children, the ammonite, the water fleas (*Daphnia*), the mealworm (beetles and larvae) and the banded snails, in decreasing order, excited most interest. A marginally significant number of younger pupils were more interested in the feather (infant/junior: $\chi^2 = 5.14$, $p < 0.05$) to talk about and the pebble to photograph, whilst a marginally significant number of older pupils were more interested in the ammonite fossil (infant/junior: $\chi^2 = 4.00$, $p < 0.05$) to talk about. Apart from this there were no immediately obvious age-related preferences.

For those six items (Figure 1) which were most frequently selected and talked about by the children (in descending rank order, the ammonite, *Daphnia*, mealworms, snail shells, carrot plant and feather), a qualitative and quantitative assessment was made of responses to the questionnaire. In the accounts below much additional use is made of significant qualitative pupil observation.

The ammonite fossil

The younger children (11 out of 12) did not recognise the ammonite as a fossil, but only as a stone with a shell-like pattern; the older group predominantly knew it was a fossil (20 out of 24) and many an 'ammonite', by name. The six year-olds had almost universally not seen such a thing before, but several of the older pupils knew them from their homes, gardens, cliffs and beaches, from walks and from museum visits (25%), where they had predominantly parental accompaniment (80%). The 10 year old pupils had clear ideas of fossil antiquity, the way in which some animals (snake/worm/snail?) had once been embedded by processes of sedimentation in the sea; a few had ideas of fossils being uplifted and the processes of their discovery through breaking rocks open.

Whereas the younger (six year old) children were attracted by the affective *sculptural characters* of the fossil's coiled shell, ribbed pattern, great weight, polish and feel, the older pupils expressed clearly additional concepts of the original animal form *printing* or *moulding* the fossil form. Only the older pupils acknowledged reading and television as sources of knowledge.

The significantly larger number of older pupils wanting to talk about the fossil ($\chi^2 = 4.00$, $p < 0.05$) arose probably from their recognition of what it was, and the wonder of its origin, antiquity and discovery. The younger children often expressed their selection of it for affective reasons of shape and form and feel and a recognition that, as they did not know what it was, they chose it as they wanted to find out more. A minority of children of both ages saw the fossil as a human construct entirely; one child saw it having a patterning that was purposive to the object – "it is like that so that it would be picked up by somebody".

The *Daphnia*

Almost none of the younger (six year old) children knew the name or even vague identity of these animals, nor had any seen anything like them before. Their aquatic animal nature was recognised (as insects/ bugs/ beetles/ creatures/ tiny fish), most children observed and described their colour, pattern of movement, swimming and moving appendages, etc. Affective feeling was strong ("they play together"; "they are orange and silver and look precious"). One child had seen organisms like this with his brother at a pond. Another found them mysterious and excitingly "scary"; another saw them ecologically ("maybe frogs eat them").

Three quarters of the older (10 year old) children claimed some familiarity with waterfleas, a minority naming them as *Daphnia*, or *Cyclops*. They were equally observant of colour, movement and behaviour. Half the children familiar with them based their knowledge on acquaintance with ponds, ditches, or aquaria, fish-keeping or going fishing. Home-derived knowledge was important (65%). Interestingly, fathers, elder brothers and grandfathers were described, by the junior age children (n=24), as their mentors. There was no gender bias in the pupils' choice of the *Daphnia* in the first place.

The mealworm (*Tenebrio*) larvae and adult beetles

These insects were much more familiar to all the children than the aquatic waterfleas, eliciting a much richer naming

Table 2. Comparison of the selections to 'talk about' and to 'photograph'.

Photograph choice: same or different from first choice	*The same three objects selected to photograph*	*The same two objects selected and one different*	*The same one object selected and two different*	*Three entirely different objects selected*	*Total*
Age 5 - 9	9	8	17	12	46
Age 9 -10	5	12	18	11	46
Expected frequency if the children's choice of objects for photography were randomly chosen	0.7	7.3	16.3	21.7	46

vocabulary. Of the younger children (age 5-6), though 35% said they had never seen animals like these before, they collectively used 11 different animal descriptors for the beetles and larvae, distinguishing the adult (insect / beetle / bug / creature / mosquito) from the larvae (maggot / worm / caterpillar / slug / centipede / millipede). Encounters with a variety of small arthropods were commonly described, with a wide range of descriptions of location outside school. These children were very keen to observe more, noting movement, colour, pattern and form in particular.

All of the children expressed a fascination with the animals as being key in attracting their choice, a significant fascination being that they are slightly "scary". These animals elicited many other animal encounter anecdotes – "my uncle's carpet was eaten by maggots, and they ate his dog too!" All 21 of the older children (10 year olds) had found similar beetles or larvae somewhere in natural environments. They used a larger vocabulary (with less taxonomic inaccuracy) compared with the younger group and additionally distinguished different sorts of beetles (dung-beetles / water-beetles / ground-beetles). Most cited habitat descriptions for beetles, based on personal experience, notably describing: dark places; damp places; in woods; "under stones and logs". The older children had some idea of life cycles, some few expressing knowledge of insect pupation. School-based knowledge of butterfly lifecycles was quoted.

There was suggestion of some gender attitudinal difference: boys only saying "weird/wicked/cool" and one girl describing insects as "ugly and in need of a make-over". Between expressed affection at one extreme and genuine fear or disgust at the other, the bulk of affective feeling was a slightly detached fascination in the animals.

Cepea snail shells

These common snails had been observed previously by almost all the children that selected them both at home and also at holiday locations. All ages knew what they were and a few had observed that snails are out of their shells and moving when the weather is wet or it is early in the day. The younger children regarded the shell as 'the home' of the snail, rather than something constructed by the snail itself, whereas the older children saw it more as a hard protective and perhaps camouflaged surrounding, reducing attack from predators. Some younger children thought that slugs were homeless snails that adopted the shells as homes. One child saw the C*epea* shell patterning as 'painted on'. All the pupils that selected these shells to talk about did so for affective reasons, liking the spiral form, diversity of patterning and colour. Some hoped that the animals were still inside and that they might see them.

The entire carrot plant

All children were universally familiar with carrots, by name and nature. The predominant reason for selecting the carrot root, intact with its leafy top, to talk about was given as familiarity with the subject – "I know all about carrots." Some appreciated that they had "just been picked". Although 46% of the pupils sampled had grown carrots in school, this sub-group did not significantly select them to talk about more than the other objects presented.

Although a minority of pupils of both ages were new to observing the leafy top intact, "it's got grass growing on it!" some cautioned that this top part was just a plant or "weed" but the part in the ground was "the vegetable". All children at one school had grown carrots but very few had done so at home. None had seen carrots growing in a farmer's field. Those who had grown them recognised that they grew from seed and that the size of the root correlated with the size of the top: one child, aged six, said "the bigger the top, the bigger the bottom".

Knowledge of the processing, cooking and eating of carrots was impressive, as was the children's association of carrots with "healthy eating" and a few children saying that carrots helped you to see in the dark ("my Daddy said") and how they are liked by rabbits. There was some key progression in knowledge: "the leaves are so you can find it/pull it up" (age 6); "the leaves are so it can grow" (age10).

The large bird primary wing feather

The younger children all recognised the large bird flight primary as a feather and immediately identified their interest in it from its size and its feel. They knew it was not from a small bird but few knew that it was from something as large as a goose or eagle. The older group fully recognised it for what it was and were significantly less interested in its novelty.

Universally, the six year-olds had discovered much smaller feathers from birds in many places; they had often picked them up on walks, knew their function in helping flight and keeping the birds warm. They were excited about the feel of the strong feather shaft and impressed by its strength and yet softness to the touch. This affective feeling was much greater in the younger group – "It is really beautiful"; "It is soft and I can feel it on my face"; "It's lovely and the best thing on the table".

The older pupils knew more about the function of feathers, citing their additional protective function. They had a clearer idea of what sort of feather it was "from the wing or the tail", and had more ideas about its use as a flying object falling "down with a twirl". They also had greater interest in fine structure (of barbs and barbules) and its potential usefulness for making a quill pen.

All children emphasised its tactility and the wonder of its links to an admired living thing.

The other objects

The frequency with which the other objects were selected for discussion or photography was similarly not equal (see Figure 1). The **salt crystals** were selected for their cuboid "square shape", shiny crystal structure. Interestingly some children thought they might be precious jewels. The **twisted hazel stick** was seen as a natural stick but curious, odd, rare and interesting to feel. The **berries** were seen as red and shiny and visually attractive. One six year old thought they were artificially-made beads. Many of the children did not recognise them as an edible fruit and some wanted to know specifically if they were at all poisonous. The large **mushrooms** were attractive for their tactility, "soft and round and (the gills) feel funny". A minority of children knew about eating them. The **honesty *Lunaria* fruits** were selected for their beauty, difference from the other objects and in one case for their familiarity. The **pebble** was selected for its tactility – its weight, smoothness and oval shape. Interestingly, the pebble was quite novel and very attractive to some six-year-old children, who wanted to keep feeling it for longer. Although not statistically significant it is noteworthy perhaps that for equal numbers of older and younger children, 46 in each case given the same choices, 12 six-year-old children selected the smooth pebble for their photograph but only one of the 10 year-olds made the same choice. The **mouldy bread** was familiar but a least favoured option! None of the 14 children who selected this option knew what a mould was, but several were aware of its nature: "it's really disgusting but I like learning about these things".

Discussion

The spontaneity and interest shown by children in objects displayed in three schools was amply evident. There was a huge appetite by children for learning from displayed natural objects. We discuss below several features arising from this study, notably: the key factor of 'animacy'; children's intrinsic quest for understanding; the source of their ideas; their development of scientific skills; and their wonder and aesthetic sense in making a choice.

Animacy

Examination of the choices that the children made indicates, first of all, a motivation that seems to derive from the relative 'animacy' of the objects (see Gelman, 1988). The interest that was expressed by these children towards the two living animals, to the 'lives' evidently associated with the snail shells and the large bird's feather and the once-living ammonite are very strongly marked. Our observations support those of Heyman and Gelman (2000) and show the importance of teaching with the attraction of animate nature in mind.

Children's quest for understanding

Children have a passion for understanding. Learning for children is not only a process of conceptual change, as alternative conceptions are discarded, but is also one where they acquire new knowledge about things as, at the same time, they also acquire and develop new strategies for learning (Kuhn and Pearsall, 2000). We have observed an unsurprising but important progression. The 10 year olds in this study are clearly drawing on a much wider range of experience and ways of approaching their display of knowledge to the researcher than those four years younger. That progression was impressive, not least because of the added ability of the older children to articulate their thoughts.

Sources of knowledge

We noted that the children in this study describe a predominantly (92%) home-based (or family outing-based) rather than school-based source for their anecdotal experience. They were keen to show the depth and extent of their knowledge of living things, objects and phenomena from outside school. This might have been a consequence of the interview process but this display of experience contrasted with sound factual (theoretical) knowledge also coming from the classroom (e.g. animal lifecycles, plant growth, etc). This would suggest that there is a deficit of hands-on systematic teaching about animals and plants *in situ* and too little exposure of children – *with their teachers* – to contact with the natural environment.

Here the relationship between current practice and best practice might be explored more. Hart (1981, in Liben *et al*) has demonstrated that the area over which a child can range freely is correlated with how well they *know* about features of their environment. Providing ample opportunity for children to experience the natural environment at first hand is immensely important for a fulfilling education (Louv, 2006). Although there is, in this study, evidence of planned environmental learning in school (e.g. one school growing carrots with *all* their six-year-olds), there was much evidence of children's individual learning out-of-doors as well (on their own or with family), much of it in 'waste places' such as at 'the bottom of the garden'.

Scientific skills

It is in this context that children's careful observation of natural objects is basic to their developing of science understanding and to the development of their scientific thinking. Klahr (2000) describes four processes in scientific thought as a whole. These are broadly described as *Inquiry, Analysis, Inference* and *Argument* and these build in a stepwise manner upon each other. *Inquiry* is the most basic of these. It is 'spontaneous' to every child, but is reinforced through observation and experience by a stimulated imagination and a developing sense of causality in the mind of the child. Here we have seen it in the way that children note differences in physical form, in perceived function and in observed behaviour. It is this that is so fundamental to developing a scientific mindset. Thus (in this study) the snail-like form in the rock is a vestige of an animal clearly *many years* old. This generates wonder. The very big feather is indicative of a very *large* bird possessing it, calling forth prior knowledge and imagination which are brought to the inference. The carrot plants, in a leafy bunch, had some prior familiarity, including a general confidence in naming them as 'carrots', but some children had not seen where a living carrot came from and were intrigued by the leaves on the top of the taproot. Through analysis, such new perceptions are evident generators of inference. With the red fruits, the question arises in the child's mind: "Are these visually exciting red berries *signalling* that they are good to eat or are they telling me they are poisonous?" Here is analysis, inference and argument in the mind of a six year old. This progression in understanding is familiar to teachers and is amply confirmed in this study.

Wonder and aesthetics

We conclude that, in addition to novelty and prior association, sensory rewards of colour, form, feel and weight are important in generating interest. A notable feature of the younger children was their *inability to articulate* why they were attracted by the items they selected. Careful questioning elicited both *wonder* and an *aesthetic* appreciation that also showed itself in the choices of things to photograph – itself an act of *possession* of something you want to keep. This is an area of early-years learning in 'science' that we feel is important but which might have been probed more deeply and systematically.

In asking "what is the very first thing that attracts a child's attention to something?" one is asking not one but many questions. It is clear, for example, that the ammonite fossil engaged pupils because of its novel nature, because of its large elegant spiral form and 'feel', because, as a fossil, many children knew it was very old and yet had once been alive so eliciting a fascination with its own ancient story. The wonder and aesthetic elements in choice are very complex to analyse. In many cases the items chosen for photography were not the same as those selected as most interesting to talk about. The *Lunaria* (honesty) fruits, for example, were selected for a photograph twice as often as an object for discussion. Over and over again the children were asked why they had selected particular things to talk about. It was clear from responses: " I just really like it", "they are so pretty", "it's just weird and interesting", that the children were operating under either an aesthetic or an ill-defined affective feeling for the object.

Educational implications

These initial findings indicate the motivational value of observing natural objects and their positive effect on attitude, as well as their usefulness in developing children's knowledge, language and communication skills. The study shows that the criteria for selecting the best natural objects for teaching (for which good teachers should have an intuitive 'feel') may be better defined where teachers seek to promote children's knowledge of natural phenomena.

To summarise, with respect to the choices, there is a clear bias towards:

- animals with actions and behaviour rather than an unresponsive specimen. Animacy is key.
- items of novel nature or appearance
- items with which children have some prior familiarity, including confidence in naming them, about which they can talk.
- aesthetic attributes of colour, shape, texture, feel, weight, size, etc.
- objects eliciting some affective feeling, emotional engagement, or anecdote.

Teachers should provide opportunities for enhancing observational skills (such as a 'nature table'). They should select a wide range of objects/organisms to enlarge children's knowledge about their own natural environment, but choose those with which children have some prior familiarity. Children will make careful observations if encouraged and allowed sufficient time. Such observations are basic to the development of scientific understanding and scientific inquiry. Children will 'read' objects for cues to understanding and such cues engender questions and children's greater interest.

Objects are valued much more where the children can make an affective or emotional link for reasons of 'animacy' or aesthetics. Furthermore, children will draw more on understanding gained through first hand experiences. There is an entitlement to such quality, hands-on observing within the school experience. Educators should cater for the kinaesthetic aspects of observing, particularly important with the younger age group, provided that such actions are ethical and safe. We recognise that children, with their 'spontaneous interest' will readily link their own observations with myths and stories. Teachers should explore these links with them, composing reality from fantasy by using the children's 'stories' to construct their own explanations.

Finally we assert that children who have the freedom to explore wastelands and woodlands, who look into ponds and ditches, who collect feathers and pebbles, who turn over stones to find beetles, who allow snails to crawl on their hands will all be 'discoverers'. Too little of this is possible in formal schooling. The over-sheltered child must often be the poorer in their learning.

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