

## Talking and Doing Science in the Early Years

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### Summary

The function of the book in encouraging talking whilst doing science activities in the early years is discussed and a theoretical perspective of the importance of the development of language and of observation is put forward. The emergence of the child as an intuitive scientist is put but the role of adults as essential facilitator is described. The purpose of the book and structure is explained. Learning science in the early years is a collaboration between adult and child.

### Big Ideas

#### The purpose of the book

Just as there is a critical period for language acquisition in the early years, I believe that there is one the development of an understanding of science phenomena. The first observations and hands on experiences of children in the everyday world, which are science in action, are critical to their future learning. The role of the adult with them in facilitating such opportunities and talking with the children are the most important part of a child's education albeit that these years are not considered those of formal schooling.

This book provides some experiences and investigations for these early science learners, who spontaneously have an investigative inquisitive approach to the world around them, that can be carried out in the home, nurseries and playgroups as well as out doors, playgrounds, parks and gardens, walking in the streets, They are not formal science teaching. We are not setting out to teach the children science. Rather we are seeking to provide them with experiences and language so that once being taught they might understand the theory having had relevant experiences. Tracing backwards from the advanced concepts of advanced school and even later science learning it is easy to identify the very first or fundamental ideas on which later theory is based These ideas or concepts are what this book sets out through various experiences for the children. Often people qualified in science know too much and find it difficult to undo this later learning and focus on the basic ideas.

Expensive equipment is not needed to provide hands on experiences in science in these essential early interactions. Items that are available in an ordinary home or other setting provide then necessary equipment as do the everyday varied environments that a child encounters.

The adults do not need to be formal science educators. All adults working with young children are science educators because they are aware of the experiences and

observations that are for the developing child to encounter. Talking about such, the child asking questions, wondering what and why, is a vital element part in the development of understanding and in communication and social skills. Without these early first encounters the child misses these crucial experiences. They are the most important in their science learning.

Their adult facilitators are experts in listening to and observation children as well as developing activities and conversations with young children albeit they are often not formally qualified in academic science other than what they remember from their formal schooling. The book summarizes the big ideas of the various topics to refresh the memory of their school science but such information is for the early years facilitator not to be told to the children unless the adult feels some information is appropriate to mention.

#### Emphasis of early years science

There has been a paradigm shift from focusing on secondary pupils to encourage them to study science to a realisation that a sound basis from the earliest years is the most effective route to educating children in science. Research (e.g. Lyons Report, Tytler Report from Australia) show that children in their early teens have made up their mind about science and the work of Tymms et al. (2010) in England suggest children have decided about science by the age of 9. Most often they are not enthused by the subject encountered in school. Alison Gopnik's book (2009) shows, from extensive research, that children are intuitive scientists in their early years before formal schooling, they observe, raise hypotheses, experiment and notice patterns, the basis for statistics and evidence.

#### Development of the child as a scientist

During their beginning years children acquire an understanding of occurrences which they notice, behaviours or objects and acquire basic science skills of observing, questioning and investigating, process skills (Eshach and Fried, 2005). The fundamental skills being in infancy as the new being starts developing and the prowess at these skills and processes increases as the child ages (Lind, 1999, Piaget and Inhelder, 2000). In these early years children develop a feel and experiential based understanding for everyday science and engineering phenomena and such are deemed of great importance by researchers, e.g. Eshach and Fried, (2005). However, it has been found (Sacks et al, 2011) that science experiences in formal early years (kindergarten in USA which is 5 years) is not reliable forecasters of future achievement in formal science learning. Furthermore, the attitude of pre schoolteachers towards science influences children, if teacher displays wonder and excitement children think science and its associated subjects is exciting too (Spector-Levy et al., 2011). Presumably the same effect is noticed in the behaviours of any adult with whom these early learners are in contact. It is thus important to remember it is not the content knowledge of the adult that is important, it is the curiosity and enthusiasm that they show that matters.

### Talk with doing

Young children need first hand concrete learning experiences with appropriate talk. They need to hear the words of science and engineering in the everyday before they can talk, for they can see and hear. Sadly, in today's world there seems to be little time for quality talk in some homes and there is less and less time at school. However, recent years the importance of "talk for learning " has been recognized but we tend to move too quickly into talk relating to abstract learning.

There is an increasing recognition of the importance of early years of a person and the interventions that are so crucial for their healthy development. The years 0-5 are those most important in a child's learning and the opportunities and experiences in these early years lay the firm foundations for later learning. Such opportunities if not spontaneously and intuitively provided need to be planned and provided through early intervention strategies a recommended by some governments, (Allen, 2011). The early years are crucial in the development of children. Pines and West (1986) showed that the impact of the knowledge that a child had acquired before they are taught formally a concept affects how they learn.

“The first few years of a child's life are fundamentally important. Evidence tells us that they shape children's future development, and influence how well children do at school, their on-going health and wellbeing and their achievements later in life. The government is clear that all young children, whatever their background or current circumstances, deserve the best possible start in life and must be given the opportunity to fulfill their potential” Allen, 2011. Early years talking and doing everyday science and engineering is surely part of this aspiration for all children?

### Scientific literacy for all

In many countries of the world a goal is to promote science literacy for citizens and scientific literacy is a feature of science educating perspirations in England. At least amongst under represented groups science learning divorced from everyday life alienate many children) e.g. Osborne and Barron, (1998). Research in the USA (Calabrese Barton et al (2001) elicited the perception of science at school in a group of ethnic minorities. 21<sup>st</sup> Century science was an initiative in countries of the United Kingdom to make science more relevant for GCSE pupils. Primary science in schools has, since it was introduced in the national curriculum in England in 1988, striven to make the learning relevant to everyday, (Scribner -MacLean, 1996) but it still misses the fundamental concepts that is the focus of early years science before the formal schooling and re the content of this book.

### The language development through science work

Observation and experience are the foundation of science learning together with being informed of names of things and processes but this early stage has to be experiential and in partner ships with a facilitator who provide the labels for the phenomenon observed and activities such as pouring, pushing.

Young children ask questions incessantly when given an opportunity (Tough, 1977), a behaviours, which often disappears in the formal educating environment where classis triadic dialogue takes over. However, there is a move towards developing dialogic talking in classrooms (Alexander, 2008) and argumentation. Yet young children before school can be inducted into such an approach, indeed many carers of pre school children carry out this type of dialogue of asking “Why?” to a child, “Why do you do that?” “What did you see?” is common.

Children need to develop the language to enable them to questions and justify for they are intuitive scientists (Gopnik, 2008). Learning language in meaningful context, exploring the everyday world, is an optimum means of developing both language skills and prowess as well as learning fundamental science. Children should be encouraged to relate that which they notice and observe to that which they already know, interpreting and making sense of objects and other phenomena for themselves. Four-year-old examining things on discovery table in her pre school picked up some seashells and looked at them. One was spiral in shape, she looked then smiled and shouted, ‘Here is a ice-cream cone!’ associating the shape of the shell with the ice-cream cone with which she was familiar The adults with whom their children have a critical role in influencing what the children observe.

Constructing meaning about the world is a social activity (Bruner 1990) and meaning is heard through voices. Thus analysis of conversations are possible developing further from just assessing the initial form and function of talk used with different ages of children. They can be categorised according to complexity of structure and content as ‘Labeling conversation’. There is progression of labeling conversations . First of all, is heard with babies/toddlers is telling the child a name for something, ever before the child talks. Then adults often open with a question drawing attention to the specimen then gives it a name which the child repeats once they talk as children that age often delight in so doing! The adult, often the mother closes these conversations with praise an example of classic IRE, initiation-response-evaluation dialogue (Chin, 2007) which can then be followed up by further talk and activities.. Often ‘the way adults talk with pre - school children who have developed further than just naming or labeling but the adult uses 'baby words, for example, 'Mum: Look! A birdie!’ Where conversation is initiated by the child and called Inverse Triadic dialogue where the child starts and closes the conversation. (Tunnicliffe. In press) followed by dialogic talk (Alexander 2008) the basis for science investigations.

Learning science is talking Science (Sutton, 1996), not teaching and telling. Talking and Listening are two of the four strands of Literacy and the first stage in literacy are acquired if they are living in an environment where they hear language. Language is a means for thinking collectively (Mercer, 2000) which are what occurs between and adult and child when Th child wants to show smelting or the adult wants to recognise the interest a child is showing about something. Mothers and carers usually spontaneously name things and point phenomena out to children in the earliest years from the time they are born.

The starting point for science is observation and adults working with early years children can share observations and talk about such thus possibly increasing their own self-esteem and confidence about scientific phenomena because they often realise that they can recognise and talk about everyday science and engineering.

Children, we now know, need to talk, and to experience a rich diet of spoken language in order to think and learn. Reading, writing and number may be acknowledged as curriculum basics but talk is the true foundation for teaching. (Alexander, 2008, 9).

### The Ideas of Children

Through their observations and investigations, as well as applying their logic, children do develop ideas about particularly causes of phenomena. Such ideas are often different to those of accepted science. Such alternative explanations or ideas are often referred to as misconceptions or alternative conceptions. They are very real to the children and are often very difficult for adults to change when the child is older, thus these early ideas can form barriers to further learning and understanding (Clement, Brown & Zietsman, 1989). Many of these concepts are not scientifically acceptable and can be extremely resistant to change (Black & Lucas, 1993). For example a four-year-old child had his explanation about why it rains and announced, *It rains because the sun shines on the tops of the clouds and pushes the rain out and it rains down to us.* (Bradley, 1996, p3). The taxonomy of animals used spontaneously by young children such as shown by the children mentioned earlier is not taxonomy at one with that of biology.

### Science of Everyday

Learning science is looking at phenomena, everyday and unusual, but looking with meaning, in other words, observing. Such looking and noticing happens before the child talks for they are listening to what their adults and others say about the objects and happenings. Once they talk they are naming what they see and asking about them comes naturally and spontaneously to most young children Pre school children are by nature scientists and they notice patterns. The same action they make or see repeatedly results in the same outcome, such as dropping an objects from a height, like a pushchair or high chair, results in the same outcome every time. The fact that this is accepted as physics phenomena and is the effect principally of gravity and mass of the dropped object depending on the object dropping does not matter to the child in this beginning science stage. Such observations are at the start of experimental evidence and data collections and thus statistics. The young scientist is establishing an understanding of apparatus. However, an adult alert to opportunities to develop the observations and experiences of the child through talking to them can help children even more in their learning of science.

For example, cooking changes ingredients. Consider eggs cooking. If a child looks at the raw egg first, noticing that when the insides of the egg are released from its enclosing shell it is not the same shape as the egg. Then the yellow albumen (the thick liquid around the yoke) is talked about and as the egg cooks the adult draws the attention of the child to watch what happens. Gradually the yellow fluid changes to a solid white material

as the egg cooks. Such observations are the basis of chemistry for this is chemical reaction.

Observation is the key to beginning science looking and noticing is the key. Young children have the time to stand and stare and ponder and make their own observations in this way they are experiencing and learning the manifestation the basics of science even if they can not yet talk to question. Before a child talks their adult often poses questions, 'I wonder what would happen if we...?' so the children become used to hearing this pattern of talking which is key to scientific learning and experimental investigations. 'I wonder what.' is the beginning of hypothesis making. 'I think so and so will happen is the start of formulating and making a prediction. Actually doing what ever was suggested is the beginning of experimental investigations.

Such an activity also involves a key aspect of learning science, that of logistics. In order to do many investigations you require the appropriate resources (Fulfilling the role that specialised equipment plays in laboratories and field work) to carry out your plan and plan of what you will do when. Science learning is not being given items to use in an investigation it is about deciding what the individual wants to enable them to do their investigations, of closure there has to be an element of instruction with some items, such as learning the skill of measuring and pouring an amount of water, weighing an object or amount using scales, but such skills are often learnt as part of being in at home or in play at preschool or child care. Such basic skills can be acquired through play and helping in a household.

Young children who do achieve something are usually so excited they tell everyone and even, before being able to speak, will lead a significant person in their lives to see what it is they have observed, found or done. Adults with young children can support such a pattern of activities saying the words appropriate to the actions and names of object. Hearing appropriate language for things and actions vital part of foundation learning in science and engineering

#### Language acquisition

The first stage in language acquisition is learning name of both things, live organisms, natural phenomena like weather, stones, water, constructed things such a buildings, jugs, bags and actions like walking, pouring, holding, pushing. Is the 'labelling' stage of learning language (Bruner, 1972)? First educators name things and actions in their everyday environment for their children and subsequently often refer to the item in a 'Motherese' term, baby talk which children also invent for selves a as they learn to talk,

A young boy of my acquaintance being told a large vehicle down the road was a digger referred to it, and any other vehicle for awhile as a " dig-dig". Adults will frequently use; baby words' for instance, I heard a mother of a toddler in a zoo referee to a vulture in an enclosure as a 'birdie'. One of my grandsons when on the river (in a boat for the first time) was so excited by all the ducks and was resistant to being told that the big white' ducks' wren called swans, that the small black birds with a while patch on their head

were moorhens whilst the large grey 'ducks' were geese. He was still at the stage when tall birds belonged to there category of " duck' and had not yet acquired the concept that dicks were birds and a particular type of bird. Mariyah who is 20 months old saw a plane in the sky and called it a 'bird' because it was flying and while watching a wildlife programme on the television she called a frog 'fish' because it was swimming in the water. She also said, as she was with her family driving up a hill 'up' but as the car then went down the other side, she said 'Wheee' instead of 'down'. We think she associated the 'down action' to coming down a slide or stairs because her parents have said that to her when on a slide or sliding down some steps.

#### A child's first word

It is an interesting exercise to write down on a significant date in the child's life the words that they say. Here is the list of words that my eldest son could say with understanding on his second birthday.

Table 1 Alan's Words on his second birthday 29.9.73

Baby Church Eye Hair Two Hand Shoe	That Hello Scissors Down Out Orange Dog	Egg Iron Onion Alan Dig-dig Bee Hole Man	Balloon Goat Pineapple School Plane Big Sauce Teeth
Shell Horse Cat Daddy Post Bricks Dougal ( his toy dog)	Hen Fridge Ball Gate Biscuit Ear Kate	Stool Bit Towel Drawer Girl Another Broken	Brush Chin Circle Lawn Shoulder Mouth Nose
Bye Coat Bang Barrow Dig Out Spoon	Spade There Bridge Me Bike Shut Tea	Turn Machine I Am Clap Tick Milk	Peter Milk Clock Phone Shave Mend
Toast Toes Boots Beans Bus	Splash Brush Push Door Home	Ring Peep Mine Bed Comb	

Date This	House Here Boat	Are Plate	
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The adults with whom their children explore the environment, inside or out, have a tremendously important role in influencing what the children observe.

‘The experiences which children have of adults using language with them must play an important part in influencing the kind of interpretation that children will make of her everyday experiences. If for example, the adult is talking about particular detail in the environment, the structure of plants the shape and colour of the rainbow, the reflections in puddles, then the child’s attention is being drawn to objects that he might not have noticed had no one spoken to him about them, or, if he had, might have remained at a level of interpretation that did not require conscious awareness of detail,’

[Tough 1977: 35]

Vygotsky, te Russian Psychologist, (1962, 1978) pointed out the importance of language and social interaction in learning. Language has two roles, firstly in social interactions between people where it acts as a social tool and secondly is used in our midst for organising individual's thinking, hence can be regarded as a psychological tool.

#### Helping children talk to clarify ideas

Signaling and then talking about their observations and ideas helps children clarify their observations and thoughts about them. People use language as a tool for thinking and are helped in this thinking by others using their language too. Mercer et al (1999) coined the term ‘exploratory’ talk where children hold critical, yet constructive conversations, with each other. However, children in these earliest of years are beginning such interaction and once they can observe and wonder about the phenomena they can beginning to be accustomed through the dialogue with their adults of opinions, observations, reasoning and explanations. Indeed there is view (e.g. Rogoff, 1990) that growing up of humans is and apprenticeship in thinking’ and is learnt through dialogues heard and in which each apprentice participates and is defined by the culture in which the child exists.

#### Using talk to focus a child’s attention

The language used by adults to a child focuses their attention on aspects of the immediate environment and thus the presence of an adult with children, affects the conversational behaviour. Furthermore, if the child has brought a phenomenon to the attention of the adult, or the adult notices the interest shown by the child, the language and social interaction used is important in consolidation of learning. No who does not talk easily with young children is not desirable. In later science learning the capability of reasoning is essential in the constructing valid scientific arguments (Wellington and Osborne, 2001). Early years children can listen to an adult reasoning about whatever is the focus of



interest and hear the 'way it is done', using evidence and knowledge in constructing a reasoned dialogue.

Ask the children!

Children need asking why they think such and such, what have they seen, have they seen something like that before? Where? What did they think?

Saidja's bumble bee

A four-year-old girl rushed into the Early Learning Room so excited because she had found a dead bumblebee. It was, she said, 'A Mummy Bee!'. On being asked how she knew it was a mummy bee she shrugged and said it must be a mummy because you get lots of bumble bees! She was not also asked why she thought it was a bee- what features did she recognise that made it a member of the category Bumble Bees or was it an insect or various biological questions of a similar nature, Saidja was however so motivated that she went and wrote that she had found a Bumble Bee on a piece of paper. She had something about which to write and she wished to do so. This was writing with meaning.

Adults using talk to help learning!

Adults trying to help children learn use talk to elicit relevant knowledge from learner, to respond to things that they say and describe the experiences they share with the students in a meaningful way (Mercer, 1996). Educators develop their dialogue to tell a story, which is frequently that of a scientific explanation for a phenomenon. These adults set the scene and create a need for explanation, (outcome of the story) which they do through eliciting differences of opinions from learners; promising clarification; using other stories to suggest ideas creating expectations; showing counterintuitive results. Adults are talking with children often in joint activities. Adults with pre school children with very young children comment about what is seen and link their words to what they know the child has noticed before, thus basing the new dialogue on the repertoire of the experience of the child

Story telling

Adults insert a variety of methods of adult-early learner verbal interactions into their story telling, which provide further meaning. These ways include demonstrations, practical investigations and discussion and use explanations. Distinct types of explanation used are knowledge and ideas of students; explaining in a story; delivering a new vision of how things are and practising using relevant language. Explanations depend on other explanations, the knowledge experience and resources of the person working with the early learners; the nature of the subject matter and the manner in which the work develops. This is the same procedure as carried out by teachers later on with older children in school (Osborn et al. 1996). Whilst these ways of talking have been studied in the classroom they are equally applicable to the home and other settings. Furthermore, different techniques for telling a story are likely to form part of the way in which parents help provide for their children further meaning in what is observed.

The message of the book is that talking and doing go hand in hand as children explore with a supportive adult their everyday world.

### About this Book

This book is designed to provide educators why interact with young children before the age of five years with starting point to help them develop play and talk with the children in their charge, at home or elsewhere. It is not about teaching the theory of science but is about noticing and experiencing everyday science in action. Science is based on observations which give rise to learning language, formulating questions and in further investigations as well as developing language, communication and social skills. However, many parents, cares and early years educators have felt that they don't know enough science the be able to effectively introduce their charges opt though this area of learning.

This book introduces any educator of pre school children to the simplest form of the principles and big ideas of science (Harlen, 2010). It is an essential start to encouraging children to have an interest and experiential understanding at a basic level of science and engineering and links the foundation upon which formal school studies are built.

### Organization of the book

The following 11 chapters deal with the following areas of science.

Chapter 1 Resources, language organization

Biological Science

Chapter 2 Ourselves

Chapter 3 Other Animals

Chapter 4 Plants

Chapter 5 Other Living Things

Physical Science

Chapter 6 Forces

Chapter 7 Structures

Chapter 8 Materials

Chapter 9 Changes

Environmental Science

Chapter 10 Built Environment

Chapter 11 Outside

Each chapter begins with a summary, the key words associated with the topic so that if you wish to, you can look them up for further clarity. A section on Big ideas follows. These Big Ideas sections are designed to refresh your memory about the background science to the topic about which the activities for the children are focused. They are not intended for you to tell to the children.

These early learners need the hands on experience together with the relevant everyday words and dialogue about them but not the theory. Other people can develop that later.

Following these first sections, each chapter contains a series of activities, which can be presented to children starting with the simplest. The resources needed are those readily available and the locations for them are those of everyday. Refer to the equipment list for ideas if you need any!

Activities may be whole group, a small number of children or one to one, depending on both children and the organization of the area and the situation.

In the activities section Talking and doing, the initial activities for youngest children are to hear the word associated with that to which it refers. Key words are provided in vocabulary lists for the book. Select from here if you want further ideas from those you already have. Without this language relationship to objects and actions they are hampered in further progressing. Talking to them is the most important start in science and engineering learning.

It is hoped that the adults working with the children will integrate the activities with others, such as drawing, painting, modeling, story reading and telling, drama recording and communicating so that the science is part of a holistic experience. I hope that the book will help you the reader to support your children's scientific learning with enjoyment for all of you.

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Everyday science all around -Resources, play, language and skills for everyday science

Learning science is talking Science (Sutton, 1996), not teaching and telling. Talking and Listening are two of the four strands of Literacy and the first stage in literacy are acquired if they are living in an environment where they hear language. Language is a means for thinking collectively (Mercer, 2000) which are what occurs between an adult and child when the child wants to show something or the adult wants to recognise the interest a child is showing about something. Mothers and carers usually spontaneously name things and point phenomena out to children in the earliest years from the time they are born.

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For example, cooking changes ingredients. Consider eggs cooking. If a child looks at the raw egg first, noticing that when the insides of the egg are released from its enclosing shell it is not the same shape as the egg. Then the yellow albumen (the thick liquid around the yoke) is talked about and as the egg cooks the adult draws the attention of the child to watch what happens. Gradually the yellow fluid changes to a solid white material as the egg cooks. Such observations are the basis of chemistry for this is chemical reaction.

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### Language acquisition

The first stage in language acquisition is learning name of both things, live organisms, natural phenomena like weather, stones, water, constructed things such a buildings, jugs, bags and actions like walking, pouring, holding, pushing. Is the 'labelling' stage of learning language (Bruner, 1972)? First educators name things and actions in their everyday environment for their children and subsequently often refer to the item in a 'Motherese' term, baby talk which children also invent for selves a as they learn to talk,

A young boy of my acquaintance being told a large vehicle down the road was a digger referred to it, and any other vehicle for awhile as a “ dig-dig”. Adults will frequently use; baby words’ for instance, I heard a mother of a toddler in a zoo referee to a vulture in an enclosure as a ‘birdie’. One of my grandsons when on the river (in a boat for the first time) was so excited by all the ducks and was resistant to being told that the big white’ ducks’ wren called swans, that the small black birds with a white patch on their head were moorhens whilst the large grey 'ducks' were geese. He was still at the stage when tall birds belonged to there category of " duck' and had not yet acquired the concept that dicks were birds and a particular type of bird. Mariyah who is 20 months old saw a plane in the sky and called it a 'bird' because it was flying and while watching a wildlife programme on the television she called a frog 'fish' because it was swimming in the water. She also said, as she was with her family driving up a hill 'up' but as the car then went down the other side, she said 'Wheee' instead of 'down'. We think she associated the 'down action' to coming down a slide or stairs because her parents have said that to her when on a slide or sliding down some steps.

It is an interesting exercise to write down on a significant date in the child’s life the words that they say. Here is the list of words that my eldest son could say with understanding on his second birthday.

Table 1 Alan’s Words on his second birthday 29.9.73

Baby Church Eye Hair Two Hand Shoe	That Hello Scissors Down Out Orange Dog	Egg Iron Onion Alan Dig-dig Bee Hole Man	Balloon Goat Pineapple School Plane Big Sauce Teeth
Shell Horse Cat Daddy Post Bricks Dougal ( his toy dog)	Hen Fridge Ball Gate Biscuit Ear Kate	Stool Bit Towel Drawer Girl Another Broken	Brush Chin Circle Lawn Shoulder Mouth Nose
Bye Coat Bang Barrow Dig Out Spoon	Spade There Bridge Me Bike Shut Tea	Turn Machine I Am Clap Tick Milk	Peter Milk Clock Phone Shave Mend
Toast	Splash	Ring	

Toes	Brush	Peep	
Boots	Push	Mine	
Beans	Door	Bed	
Bus	Home	Comb	
Date	House	Are	
This	Here	Plate	
	Boat		

The adults with whom their children, or learners from their school, visit a zoo have a critical role in influencing what the children observe.

‘The experiences which children have of adults using language with them must play an important part in influencing the kind of interpretation that children will make of her everyday experiences. If for example, the adult is talking about particular detail in the environment, the structure of plants the shape and colour of the rainbow, the reflections in puddles, then the child’s attention is being drawn to objects that he might not have noticed had no one spoken to him about them, or, if he had, might have remained at a level of interpretation that did not require conscious awareness of detail,’

[Tough 1977: 35]

Vygotsky, te Russian Psychologist, (1962, 1978) pointed out the importance of language and social interaction in learning. Language has two roles, firstly in social interactions between people where it acts as a social tool and secondly is used in our midst for organising individual's thinking, hence can be regarded as a psychological tool. Signalling and then talking about their observations and ideas helps children clarify their observations and thoughts about them. People use language as a tool for thinking and are helped in this thinking by others using their language too. Mercer et al (1999) coined the term ‘exploratory’ talk where children hold critical, yet constructive conversations, with each other. However, children in these earliest of years are beginning such interaction and once they can observe and wonder about the phenomena they can beginning to be accustomed through the dialogue with their adults of opinions, observations, reasoning and explanations. Indeed there is view (e.g. Rogoff, 1990) that growing up of humans is and apprenticeship in thinking’ and is learnt through dialogues heard and in which each apprentice participates and is defined by the culture in which the child exists.

The language used by adults to a child focuses their attention on aspects of the immediate environment and thus the presence of an adult with children, affects the conversational behaviour. Furthermore, if the child has brought a phenomenon to the attention of the adult, or the adult notices the interest shown by the child, the language and social interaction used is important in consolidation of learning. No who does not talk easily with young children is not desirable. In later science learning the capability of reasoning is essential in the constructing valid scientific arguments (Wellington and Osborne,



2001). Early years children can listen to an adult reasoning about whatever is the focus of interest and hear the 'way it is done', using evidence and knowledge in constructing a reasoned dialogue.

Children need asking why they think such and such, what have they seen, have they seen something like that before? Where? What do they think? A four-year-old girl rushed into the Early Learning Room so excited because she had found a dead bumblebee. It was, she said, 'A Mummy Bee!'. On being asked how she knew it was a mummy bee she shrugged and said it must be a mummy because you get lots of bumble bees! She was not also asked why she thought it was a bee- what features did she recognise that made it a member of the category Bumble Bees or was it an insect or various biological questions of a similar nature, Saidja was however so motivated that she went and wrote that she had found a Bumble Bee on a piece of paper. She had something about which to write and she wished to do so. This was writing with meaning.

Teachers use talk to elicit relevant knowledge from learner, to respond to things that they say and describe the experiences they share with the students in a meaningful way (Mercer, 1996). Teachers develop their dialogue to tell a story, which is frequently that of a scientific explanation for a phenomenon. Teachers set the scene and create a need for explanation, (outcome of the story) which they do through eliciting differences of opinions from students; promising clarification; using other stories to suggest ideas creating expectations; showing counterintuitive results. Teachers are talking with children often in joint activities. Adults with pre school children do the same, with very young children comment about what is seen and linking their words to what they know the child has noticed before, thus basing the new dialogue on the repertoire of the experience of the child

Teachers insert a variety of methods of teacher- learner verbal interactions into their story telling, which provide further meaning. These ways include demonstrations, practical investigations and discussion and use explanations. Distinct types of explanation used are knowledge and ideas of students; explaining in a story; delivering a new vision of how things are and practising using relevant language. Explanations depend on other explanations, the knowledge experience and resources of the teachers; the nature of the subject matter and the manner in which the work develops. (Osborn et al. 1996). Whilst these ways of talking have been studied in the classroom they are equally applicable to the home and preschool situations. Furthermore, different techniques for telling a story are likely to form part of the way in which parents help provide for their children further meaning in what is observed.

Although everyday verbal exchanges have a social function, the content and form of visitors' speech is dependent on three main factors. The situation in which it occurs (Britton 1970: 97); the rationale of the visit, whether that of a family during their leisure time or of a school during educational time; the composition of the groups, all affect the talk and its outcome. Therefore, whilst the dialogue at animal exhibits may contain elements of two distinct functions of leisure and education it also possesses a distinct 'animal exhibit' style of dialogue.

The content of the conversations that are special to the context of primary school aged children looking at animal exhibits, either with families or school groups, and whether the children, and their accompanying adults, employ 'zoological' language or 'everyday' language, or both, when referring to the animals is important to recognise. It is also necessary to understand the form of conversations to ascertain to what extent teaching and learning dialogues are used at animal exhibits and whether the animal engenders such comments without the presence of an adult. Furthermore, as adults concerned with assisting children to have the best start in learning since, it is crucial to understand how these words are understood, acquired and used in conversation and whether the experience of viewing the exhibits helps the visitor to acquire biological knowledge.

Conversations are verbal interactions between at least two people and have functions, which are determined by the individuals or institution. A tool is needed to provide insight into the content and form of the conversations during visits to museums to look at animal exhibits so that educators can assess:

- the content and form of conversations at animal exhibits and whether this differs with the composition of the conversing group;
- whether the message of the exhibit was received by the visitors and reflected in the content of their ensuing conversations at the exhibit.

Studies of language in isolation provide an understanding of the essential framework, which is a starting point in understanding the tool afforded by analysis of conversations, However, that whilst language has generic features, it is appropriately studied in the context of its use, for language, in both written and verbal conversations, is, 'the ethnography of speaking' (Sinclair and Coulthard 1975).

There are two component characteristics of conversations, the form and the function. The form is constructed from individual words, which build strings of words, called utterances, the content of which, at animal exhibits, is the focus of this study. Yet the function of the utterances varies, depending on the social settings in which they are used. However, one of the functions of conversations is to represent the thoughts and experiences of the conversants that interest them and therefore an analysis of the content of conversations will indicate the topics, which attract the attention of young children. The very process of conversing turns confusion into order, enabling the participants to construct and increasingly faithful, objective and coherent picture of the world' (Britton 1975: 105).

Conversations can be grouped (Halliday 1990) according to the basic overall function for the initiator of the dialogue. Those ideational exchanges that are based on observations are referred to as 'experiential', just noting facts. Exchanges are 'logical', where the viewer/speaker seeks to make a relationship between what is seen with what they already know or, in the context of this study, what the visitors observe in the animal exhibit and what they already know about it. Thus, categorisation of the type of conversation reflects content determined by the speaker, and does not consider the receiver and their reaction. It is a one-sided categorisation and as a child acquires language skills it may be their

conversation not that of the adult.

Conversations have five definite parts. Firstly all the participants share a language style and they carry this out in a shared setting furthermore, each of the talkers expects a certain outcome for their conversation. Any conversation has a definite form or shape, judged by the tone and form of the words, for example another asking a question has a very different form from an adult giving an instruction. 'Shall we go outside' is very different in both forms and function from the declarative, 'Go outside'! Last, but not least, the conversation has a subject! (Hymes, 1972).

An alternatively any conversation can be considered by an outsider as a co-operative interaction and a witness can identify the phases or components of the conversation, a transmitter, who originates and then codes the communications. Then the actual act of physical transmission what has been composed which a receiver who once they have 'captured' the communication, words or actions, decodes the transmission then receives. Then the receiver has to make sense of the transmission, do they understand the words or actions? If the receiver does understand they may then use the information in actions or further meaningful communications. If they do not the transmission had no meaning for them although the transmitter may claim that they told them. Such non- receiving of a communication happens quite often in teaching and learning. Just because the teacher tells a child something it does not mean the children understood the information or interaction even if they did receive it!

Each participant understands the transmission of the other party and can effectively decode the communication, this aspect is important when talking with young children because an adult may transmit, in a language for which the receivers do not have the code. Furthermore, when talking with several children even those of the same age, but at different stages of language acquisition, the children and adult may not share the same code and therefore the result is that they do not understand the transmissions from each other. We have to remember too that the function of a conversation determines the form it takes; therefore an analysis of the form becomes a tool, which enables an analysis of function (Britton 1970). Thus, language in a communication is not only composed and given or transmitted, it is received and understood. Conversations are, fundamentally, the exchange of the perceptions of the communicator with a recipient about a topic. It is useful to listen to the language of children at play to identify these aspects.

Investigating- Before embarking on the activity.

When planning what to do bear in mind the following organisation aspects:

- \* Available space for talking and thinking and the doing.
- \* Equipment/ resource availability and location
- \* Adult help
- \* Other activities in the room
  - Needs of children
  - Vocabulary to be used

- Questions to use
- The pre experiences that the child needs before he can effectively be involved in this one, such as knowing water is wet and that it take the shape of its container in the case of the washing up example.

Children learn by doing. Their initial discussion is a form of predicting and their predictions will be a refinement of what they think will happen based on previous experiences (Hypothesis). Their ideas may be to us extravagant but with practice and hands on experience the children refine their ideas and expectations.

### Points to Consider

When planning any experiences bear in mind:

\*The aims of the activities are more often two aims in everyday tasks that provide starting points for activities, those of the science and those of everyday life, such as washing up for you but learning about the properties of water and soap and the actions of a force with a cloth on a plate with dirt on it.

\* Details of appropriate pre experience (if the children do not have the pre experience suggested, it is important to allow some time for free play with the equipment).

A list of equipment. All the activities use familiar every day items or those, which are readily found in playgroups and reception classes. They can be bought from suppliers of early years educational materials like The Early Learning Centre,

The following is a list of some basic items with which science can be experienced in the early years:

Plastic dishes and trays. Yoghurt pots or similar plastic containers, kitchen towel, wooden spoons, metal spoons, plastic spoons, forks knives, stirrers, bowls of various sizes, jugs of various sizes, measuring jugs, syringes (such as the ones used for giving liquid measures, mirrors, fridge magnets, torches and other items of the household with batteries, string, play dough, scales, paper, cardboard, hole punchers, selotape, play sand, balloons, toy cars, building blocks, pencils, tapes, plastic bags, straws, zip lock bags, spoons- metal and wooden, various fabrics, felt tip pens, kitchen towel and filter papers, paper straws, plastic straws, bendy straws, cardboard tubes, magnifying glass, plant pots, soil, trowels, cameras, ice trays and fridge, stove or heat source. Cooking ingredients. Vinegar, bicarbonate of soda, salt, sugar. Soda of some type in a screw top bottle. Washing up liquid, soap, wax crayons. Heat strips, potted plants. Seed trays, seeds, plant cuttings, plantlets- e.g. of Spider Plants, willow twigs, piece soft wood cut across, pebbles, stones, fossils, construction paper, wipes, Cardboard, still card pieces. Plastic covers for tables, toy cars, pictures, posters, and clippings from journals, newspapers, of animals, plants, and natural phenomena such as wetlands, streams, ponds, seas, rivers, volcanoes, rock formations. Plastic beakers, card beakers, mugs, various pieces of fabrics. Wellingtons, flip-flops, trainers, shoe, slipper, rubber bands, dish, plastic lids, bottle tops, empty boxes of various sizes soil, trowels, plastic sheeting, wipes, mirrors, serving spoons, wax paper,

rain hats, umbrellas. Droppers, pieces of chalk, marble chippings, small watering can with rose or 5ml( medicine syringes), lids from various bottles and containers.

Ideas for discussion questions before and after activities.

These are solely suggestions to initiate the dialogue with the children and are provided for those adult workers who find it a little difficult to get started in the discussion. Often just using one questions suggested triggers dialogue and no more of the set questions are needed.

A list of related vocabulary for the adult. This is provided as a trigger for the adult who may wish to plan the use of these key words for each activity into his/her dialogue. If they are not appropriate words to use with a particular set of children or need extending further the adult will take this decision. Work these out, but for the suggested activities in this book there will be suggested vocabulary list

Information giving is keystone of teaching and learning. Once a child has words to use hearing their explanations and decisions of objects and actions and obis vital for their scientific development. Helping a child to find out more for them through questioning is crucial in developing everyday and later science. Effective questioning is keystone of science learning and an essential component of Talking Science.

## Vocabulary

Talking science obviously involves language and talking is an important part of problem solving which may be a process you wish go introduce to children with whom you are working, challenging these early learners to find an answer through observations or experimentation to a challenge you set (Tunnicliffe, 1990) or encouraging to think about aerie and after situations and then Think and Do (Tunnicliffe, 1989). Children should be encouraged to talk about that which engages shier intersect and what they see and about anything that they remember about this situation or phenomena that they have met previously. From their earliest years children need to hear words so that learn to associate them with objects and actions. Talk aloud!

Whilst these early learners may hear many everyday words that may suffice for what you talk about, there are words of mathematics and science as well as those of everyday English for example actions, positions and resources movements and materials which you can introduce in your conversations and talk-alouds. This section introduces the beginnings of questions, called STEMS, as well as vocabulary in different categories, which may be useful in thinking f our dialogue. Perhaps making a list of these words and others, which you consider relevant to tasks and talk you and children are undertaking and keeping a record of which are used and with which a child enjoys and feels more comfortable and uses!

STEMS are the word used at the beginning of a sentence, particularly in the case of a question but also in directed observations. Often used STEMS in science talk are as follows.

Can you....? E.g. can you see that cloud in the sky? Can you hear that noise?

What is ? e.g. what colour is that plant?

Where is? E.g. where is that noise coming from?

Can you....? Can you hear a noise? Can you fill up this jug with water please?

How can we be sure that is...?

What is the same and what is different about....? Two clay shapes of similar size but different coloured clay

Why do \_\_\_\_, \_\_\_\_ and \_\_\_\_ look similar, E.g. Of the two green plants one has flowers, the other does not, one has leaves with parallel venation one has leaves with branched venation.

What is different about...? E.g. the two green plants

How would you explain....? E.g. Two flowers on stems each in a vase, one vase has no water and the flower stem has drooped.

Where do you think that ...? E.g. Animal lives after seeing a Bumble Bee in a garden on a flower

Why do you think .....? E.g. why do you think the Bumble Bee lives on the plant?

What does that animal tell us about itself and what it eats? E.g. watching a butterfly or bee in a flower gathering pollen

What is shared by. e.g. two different shapes that weigh the same amount...?

Why is \_\_\_\_\_? E.g. The puddle disappearing, the sun 'gone in'?

Is there? ..... The same amount of water in this beaker as there was in the jug before you poured all the water out of the jug into the beaker?

Is the amount of clay in that shape the same as was in the ball of clay with which we started?

How did? ..... you change the shape of that piece of clay?

## Bilingual children

Some children speak one language at home and another in school, twenty five percent of Welsh schools are Welsh medium but the children are speaking and spelling at home and at school in the same place if they are Welsh born. Other children come to a country from an area with a very different culture and mother tongue, which is not available in the schools in the country in which they are living. These children require a special awareness. Reported in January 2006, 'at primary school, the largest minority ethnic group is the Pakistani group which accounts for 3.3% of pupils, followed by White Other pupils (2.6%) and Black African pupils (2.5%)' ( DfES, 2006). Statistics taken from the school census reported in the Guardian newspaper on 23<sup>rd</sup> June 2011) show that 24.3% of all pupils in English State schools (primary and secondary) were from an ethnic minority and increase from 21.95 five years before. The number of children in English schools whose first language was not English was 12.3% a rise from 10.5%. Two London boroughs, Newham and Tower Hamlets had 78.4% and 78% of children whose first language was not English. Such children have particular needs; a small study in 2011

investigated the understanding and knowledge of everyday plants and animals amongst bilingual children in a North London preschool. The results showed that that pupils referenced the home as source of their learning and not school. School was not the main source for pupils learning about these organisms and their habitat. They were recognized animals and plants with which they came in contact, named their habitats, used scientific naming which improved their English language and recognized the contributions of both their home, culture and first language to their learning, (Palmer, in press). Children match that, which they know to that which they see and identify accordingly. A toddler watching penguins at a zoo floating on their water, waiting for the keeper to bring their fish at feeding time, said to his mother that they were ducks. Indeed floating penguins do indeed resemble ducks. Only when they clambered out for the fish the keeper brought to the side could the child see that they were not ducks.

### Skills for everyday science

Children need to be able to sense their everyday environment through seeing, hearing and touching as well as feeling the environment such as ambient temperature or wind presence and speed. If children are physically capable of doing so they need the manipulative skills of holding, picking items up and putting them down, of touching and feeling gently, of being aware of smells and other feelings that abound in our everyday environments.

### Starting the science process

Science is not only about content, information and facts; it is about the process of doing science. This starts with observations, noticing, asking what something is, learning objects or happenings, naming or labelling and noticing features and properties about whatever the object is- its colour, shape, sound for example. These young investigators (Gopnik, 2009) spontaneously observe things and ask questions, think of investigations and try out things and see patterns (Collecting data) and often draw conclusions, frequently sharing that which they have found out from their investigations. Babies in a high chair or pram or push chair usually drop an object over the side, again and again and again, providing someone else picks up the object and gives it back to them, and they repeat the experiment. This is a scientific investigation, each time the item is let go it drops to the ground. Science educators try to formalise the science process. It is often easier to see this process in physical activities rather than biology which is when concerned with organisms and what they look like, where they live and their habitat and wider environment.

Babies thus learn about the world around them in the same way older people learn since for themselves as individuals or researchers. The characteristics of science is experimenting analysing the data obtained since as well as composing explanations or theories for themselves about the world physical and biological and emotional. One of the problems for adults trying to understand how the very young learn science is that

babies don't talk a lot, or at all in their earliest years! Therefore psychologists have studied what babies do and interpreted their actions and decided they are working in the scientific method. Parents and people working with the youngest children do notice that babies are intrigued by new objects and actions and can work out the feelings of adults in certain instances (Gopnik and Seiver, 2009) and alter their actions so as to please or help the adult. Researchers have found out that babies in fact have a perhaps instinctive feel for physics, such as the path along which objects move and gravity, as exemplified by the high chair. Babies are intrigued when they observe an event which does not fit in with their understanding of what should happen. Young children can work out cause and effect too and given something will investigate to see what happens and very quickly can work out how to make something simple work, like the mouse of a computer, a television controller. Moreover, they often experiment until they obtain a result. Play thus is an exploring of their world and objects and other phenomena within it that they encounter

### Questioning

Once observations are made which is very much what talking science is, they begin to question and ask Why? And in many instances of physical science, ask what happens if...? and suggesting that they could perform some action or investigation to find out, suggesting indeed what might happen. This is the beginning of putting forward a hypothesis which is part of the science process and As a child gathers more concrete experiences of their everyday world they begin to use what they have already learnt and observed in forming their ideas of what they want to do to test out something. They use rapaciously acquired skills and knowledge. In formal education these stages become slotted into levels and when a child has acquired competency in the action or thought are said to have attained that level of development. In biological observations they more often make long observations by first looking and often touch or otherwise observing and then ask questions which would lead more advanced science investigations to formulate experiments to find the answer, such as when looking at some fish in a stream, a young three year old wanted to know what they were (A labelling activity learning the name), and then what they ate. He made a few suggestions like the weed he could see, but those thoughts went no further. Another early years child wanted to know about the petals on a flower in their garden.

First he looked hard and long, then he touched a petal, next he pulled its tip (applying a force!) and observed what happened, He had pulled off the petal. Petals were removable! He had conducted an investigation of his own without formally announcing his thoughts and the science process- but he did a spontaneous investigation.

Actions of young children as part of the scientific method



The following information is to advise you of where the activities that you are observing, facilitating or actually sharing carrying out with these pre school children do fit in the theoretical structure of a science investigation. Through encouraging young children to follow their intuitive scientific instinct it really is laying the foundation for further science and language work when they start formal education. It does not mean you have to make home or playgroup or learning centre experiences fit their explorations into this pattern! That comes at school when we hope they are firmly established as apprentice scientists.

Science is about observing but sometimes we use equipment to assist in the process. Describing observations is the first stage in using equipment and sometimes using a magnifying glass or a magnifying sheet is helpful when the child is looking at for example a flower such as a lily and seeing the pollen grains (male sex cells) on the stamens (male sex organs) or an ice cube melting. Often scientists measure their investigations in some ways, it might be measuring the amount of liquid they have added to something, weighing out the items they have used just as we do in cooking for using specified measured amounts of ingredients or marking the length of the distance something moves or the temperature of something else.

### Measurement

Young children often spontaneously by instinct use non-standard measures, the number of their paces or steps their toy car travelled for instance, the hotness of something using their hands, the weight of something by picking it up or comparing the weight of two similar things one in each hand to decide which is heavier. They may measure the amount of a liquid by filling an ingrained that they know so a bottle of a drink might contain here beakers full of the drink for example. Many young children are familiar with taking medicine which might be a medicine spoon full but more likely these days given as the measure of the canteen soft a small syringe, given this is a measure although in the case of the syringe it is calibrated and an excellent tool for introducing children to standard measures. Enough ways of bringing standard measures to their attention is the use of temperature or fever strips for body heat, rulers and tape measures for distance and height, scales and balance for weights of items such as suitcase when going on a flight for a holiday somewhere or at the surgery of the doctor to measure growth or in cooking where they help weigh out the ingredients using masses of known amounts, measuring the amount of fluid using a measuring jug. If the child can select the appropriate way to measure something and even more advanced be able to select appropriate instrument to use they are becoming quite advanced! Once at school they will meet the scientific and mathematical apparatus used academically.

### Fair tests

The recognition of variables in investigations is an important part of the science process. First of all, if a child does investigation spontaneously or makes an action to experiment

for themselves. Traditionally an early learner of science has to be told what to do, but most children in the everyday world do these actions spontaneously because of their inherent natural curiosity. They are able soon to point out the differences between perhaps the start of their investigation and the end, the difference as for instance between the ingredient start when not cooked and the outcome of the meal, the cooked food. They can tell you what has changed and in science terms the things that changed are the dependent variables and the treatment that happened, the cooking at a certain temperature the independent variable with everything else staying the same as control variables. Children often say things are not fair and this is recognition that not everything is the same. The aim in primary science work children are expected to be able to design their own investigations as fair tests and identify that which changes and that which stays the same and the one thing that is changed.

### Recording and communicating actions and findings

As they learn formally further science children are expected to be able to record what they do and then communicate to others their ideas their action plan, their results and what they found out. Talking science is the beginning of these science communications when they talk to you about what they are doing and answer questions. Often children will draw or act out an interesting experience such as themselves flying a kite after that have joined in this activity or pretending to be a baby chicken hatching out of an egg after seeing this happen. Children talk about what they notice and this ability is the start of drawing inferences, the ability to be able to identify and verbalise difference between items such as a tall tree and a low bush where there is height difference or a red car and a blue car, white solution and a red one, a heavy ball and a lighter one, are the beginning of this scientific skill. A development of this ability is to be able to recognise that things many change over time. The fact that in winter an apple tree has no leaves and no apples comes as a surprise to young children if they have first seen such a tree in the summer when it had fruit and leaves and when they visit their garden again rush out to see the apples on the tree and are perplexed that there were first of all no apples, secondly no leaves, a bare tree.

In being with early years children an adult can ensure that experiences that introduce and develop the skills mentioned above are available and even introduced to them along with the language and forms of talk such as questions. Adults naturally use several techniques when talking to very young children. In the first years of life Mothers often make a commentary about what they are doing, what is happening, what actions and objects are involved? Some Mothers even label items with name cards and say the name pointing at the written words. They use two ways of speaking referred to by Wretch (1985) of establish a referential perspective when the adult realises the child with whom they are talking does not understand the adult finds something related about which the child has understanding. For example had my grandson had never seen a duck or other water bird and showed incomprehension of that subordinate category of bird. I could have talked about the duck being a kind of bird like the one that comes to the bird table in the garden. When the adult thinks that there is shared knowledge between them and the child they miss out the relating dialogue, thus 'abbreviating' the reference. Wretch called

this technique abbreviation. In summary the adult is scaffolding the learning experiences for the child, first of all helping the child develop understanding and then withdrawing the language prop as the child acquires the understanding and can do without the extended description related to previous knowledge. The child shortcuts to that knowledge them self.

### Vocabulary to introduce when talking science with young children

Talking and listening are the first stages in learning. Children talk about that which they do and observe; they notice patterns and experiment, spontaneously working things out as they do so. Increasingly, the importance of hands on experiences are recognised as essential precursors of acquiring formal science knowledge and skills. The starting point for the learning of science and engineering is at this early age. This beginning of learning occurs in the immediate environment of the child with the people with whom s/he spends their time. In these locations children witness everyday activities such as cooking, cleaning, washing, various activities with materials such as textiles, wood, clay, as well as identifying and being involved with basic life processes such as moving, breathing, eating excreting and the human activities associated with the life processes and beyond.

Children are immersed in their environment, built, human constructed or natural such as their village or neighbouring biological phenomena. All these places contain various amounts of technology and biodiversity from a simple cooking vessel being used on an open fire to mobile phones; from natural degeneration to manicured garden. Moreover, the natural environment is comprised from physical, geological and biological and features of this such as rocks, plants, watercourses may be observed. Additionally, the culture and particular uses of science and technology by the community with whom the children live are evident and noticed (Tunnicliffe, 2009).

In their everyday environment at home day care, play group nursery or with other people these young children hear talk. They hear tones of voices; they hear words and gradually associate a particular set of signs with an object person or action. It is vital that their adults talk with them and describe what they are doing, what is happening, what things and actions are called as well as expressing emotions using words as well as actions. Any of you who have learnt a language not your mother tongue may recall that before you can speak the language all you can understand some of the words gradually, so it is with our early learners. It is so important in learning science that these potential scientists hear the name for plants, animals, physical and chemical phenomena and engineering in action that you see in the everyday. It is important to share the information with them. Ask them questions, point out what you see or name and explain that which they point, find and otherwise show interest. Remember too that the children hear voices on through DVDS and televisions as well as the radio. Some of the programmes they watch and hear are designed for early learners, other are not but children soon become very aware that language is a part of their world. Any visit outside the house, and indeed when visitors come to the house or place where they are, bring these children into contact with a variety of signs including voices with words. In fact words form a very important component of the stimuli in the lives and thus it is very important to provide a child with

the optimum help in developing and understanding of the vocabulary. There is an old English saying that Children should be seen and not heard! Indeed, they need to learn words before they speak them, but they listen as the first stage of talking! Just as there is a article period for language development so too perhaps these early years when children appear, as Gopnik shows in her research (Gopnik, 2008) to be instinctive scientists, is the critical time for science awareness and understanding to be consolidated. If the opportunities are missed an enduring interest and feel for science and engineering may be lacking.

The starting point for science is observation. We aim to encourage their carer to share the observations and talk about such and increase their own self-esteem and literacy.

Children, we now know, need to talk, and to experience a rich diet of spoken language in order to think and learn. Reading, writing and number may be acknowledged as curriculum basics but talk is the true foundation for teaching. (Alexander, page 9).

Furthermore. it is now accepted that there is an intimate link between language and thought and thus the cognitive development of a child is affected to a considerable extent by the nature, context and forms of language, which s/he hears and uses (Halliday, 1993). Children need to hear adults talking and be talked to by them about what which they notice themselves or that which you deem important to bring to their attention, an object, a happening or an action.

Is it important to hear words before a memory can be associated with them and that which, action or object, they stand for? Psychologists (Morrison and Conway, 2010) has discovered that in later life memories from childhood are recalled when certain words are mentioned. Such words associate with activities, places, objects and emotions and they also discoed that the memory that was recalled occurred a few months after the time when the word had been acquired, indicating that there was lag time between hearing and learning the word and associating it with a related memory. Perhaps therefore, in the case of learning science and engineering, the hearing of a word associated with an appropriate event is needed before the activity which could be associated with the word at home or school and hence the importance of children from their earliest years hearing the relevant and appropriate words spoken by the adults around them, including the media aimed at the early years, programmes such as on CeeBeebies in the UK for example.

The words that are frequently relevant too talking Science are grouped into categories for ease of reading but some fo the words hit into several fo the categories and hence are repeated, for example, full is a Quantity word but is also a measurement word. The list is by no means complete; you may well have words that you would add for your use.

However, a word of caution, a child may understand words particularly those that stand for this but when the word is combine d with other letters and sounds they at they do not ebonise some misunderstanding from an adults point of view occurs although to the children their answer or explanation is perfectly obvious. Four year old Tilly, from

Mauritius but at school in North London, knows a great deal about caterpillars and how they spin cocoon and whilst inside change into butterfly. When her teaching assistant her what caterpillars ate she replied, (Rats!). Upon being questioned she answered that cats eat rats, hence she reasoned as the cat-er-pillar was a cat of some sort it too must eat rats!

#### Observation words

#### Descriptive words

Wet, dry, big, little, light, heavy, see thought, transparent, opaque, translucent, uneven, resistance, friction, shadow, reversible, old, new, young, fresh, smell, look, under, side, above

bendy, crumples, crumbles, solid, flexi, floppy, squashed, flattened, wobbles, falls, tilts, stretch, pings. shorter,

#### Communications

Draw, tell, explain, question, answer, write, act, sing, dance, explain, mime, act, signal tell

#### Quantity Words

More, less, empty, full, equal, more, less, same a lighter heavier wet, dry, shiny, dull, overflow, particles, lumps,

Make them comparative by adding as another word e.g.. Same or than e.g. same as this one but more than that one and less than this one, or thna more than this....

#### Measure words,

Time, minute, capacity, weight, mass, measures, non- standard, hand span, finger length, foot length, width, length, Height, column, half, estimate, guess, quantity, spoonful, cupful, jugful, drop, fraction, weightless, less tuna, more than, bigger than, smaller than, same size

#### Movement Words

Push, pull, force, roll, pick, fall, rise, stop, skid, shuffle, skip, hop, run, swish, swing, squash, shake, absorb, dissolve, disappear, evaporate, solidify, runny, fast. Slow, float, sink, swim, walk, run, jump, skip, wave, support, hold, grip, gravity, sink, collapse, steady, bubble, still, wobble, bubble, bend, curve, crawl burrow, climb, fly flap creep hop skip quickly sway, hang, glide, float, tilts,

#### Action words

Push, pull, tear, twist, fold, crunch, squash, flatten, blow, release, scoop, build, burst, on, off, topple, cook, change, drop, watch, listen, smell, measure, feel, weigh, observe, look, prod, pour, sift, shake, mould, scoop, bend, open, stroke, pin, fix. Taste. Hold, grip, pinch, collide, spray, twirl, measure, heat, cool, dry, wet, switch, join, halve, Balance, corner balance, rub, drag, solidify, melt. Quick, slow, displace, suspend, and hang, attract push away, repel. Spin, stamp

### Materials

Paper, card, clay, plasticine, lay dough, soil, sand, water, liquid, fluids, paints, brushes, pencil, rods, sticks, rulers, crayon, paints, scissors droppers, straws, tissue paper, beakers, cups, plates, bowls, dishes, containers, boxes lids, trays, spoon, fork, knife, glass, saucepan, pot, kettle, bottle, scales, masses, weights, ice water, fizzy drink, bottle top, tones pebbles, rocks, salt, sugar, pal tic, powered, steam, gas, electricity, plug, rulers, metre rille, tape measures, string, thread, fabrics, filter paper, kitchen towel, cloth, materials, wool, nylon, silk, cotton, plastic, foil, syringes, tubes, rope, twine, straw, sandpaper, pins, needles, paper clips, scoop. Glue. Paper clips bucket. Tap, fountain, garden, seed tray, packet, stop clock, timer, egg timer, funnel, sieve, brick, cube, block,

### Change words

Disappear, evaporate, cooked, cold, hot, bigger, smaller, broken, rough, smooth, melt, solidity, expand, contract empty, fill, heap, flatten, steam, gas, solid, stretches, goes back, mix, disappear. change

### Colours

Red, orange, yellow, green, blue, indigo, violet, purple crimson, pale, dark, pink, white black, ivory, grey brown, russet, spotters patterned, stripes, blocks, faded, vivid, bright, coloureless, transparent

### Shapes

Circle, square, triangle, line, egg shaped, ellipse, rectangle, diamond, rhombus, pentagon, hexagon, sheer, globe, cube, dots, base, pyramid, spots. Splodges, jagged, symmetrical, mage, piece, part, fragment

### Position

Stand, flat, sideways, upside down, right way up upright, besides, alongside, together, separate, apart, clover, shade, hole, hollow, top bottom, under, above, straight, line, curve, bend, back, front, next, underneath, inside, outside, beneath

### Animal words

Fish, insect, spider, worm, animal, bones, non boned, jelly fish, skeleton, water skeleton, hydrostatic, vertebrate, invertebrate, bee, wasp, ladybird, Daddy Longlegs, Mosquito, water boatman, dragonfly, fly, midge, bird, seagull, magpie, robin, blue tit, pigeon, blackbird, staling, woodpecker, moue, frog, toad, tadpole, newt, goldfish, stickleback, tropics fish, crib, sea anemone, barnacle, mollusc, slug, snail, shrimp, horse. Cow, sheep, goat, cat, dog, hamster, gerbil, earthworm woodlouse, beetle, ant, owl, donkey, octopus, zebra, lion, deer, pig, boar, elephant, tiger, leopard, bear, primate, monkey, gorilla, chimpanzee, pheasant, fox, badger, larval, adult, change, metamorphosis, egg, hatch, grow, adult front end, back, anus, post anal tail, mouth, tentacles, feelers, antennae sudsier skeleton, exoskeleton. Crustacean, dinosaurs reptiles, snakes, amphibians, fur, spines, wool, prickles, hair, scales, eardrum. Ear flaps, tail, teeth, jaws, wings, banal cars, mouth parts, teeth, claws, nails, hair, whiskers, noises, song, bark, sing, chirp, hoot, roar, purr, meow,

### Plant Words

Green, flowers, flowering plant, non flowering plant, fruit, seed, petals, sepals, leaves, stalk, roots, root hairs, embryo, cotyledons, fruit, pollen, stamens, anther, filament, stigma, style, sex organs seedless, cone, spores, capsule, pollination, fruits dispersal, germination, water split, radical, pod, scent, colour, guide lines, wind, ripen, bud, drop, deciduous, evergreen, needles, waxy, holly, prickles, potatoes, underground stems, stolons, brambles, nettles, conifers, herb trees, bushes, twigs branches, trunk, bark, turgid, flop, upwards, downwards, photosynthesis, geotropic, energy, sun, food, vegetative, reproduction, grafts, cuttings.

### Human Words

Hand, foot, arm, finger, toes, knee, back, front, abdomen, chest, thorax, neck, head, skull, bones, blood, bleed, air, breathe, ears, eyes, nose, mouth, chin, teeth, incisors, canine, molars, nails, excrete, urinate, waste, good, chew, suck, swallow. Breathe, respire, beat, digest, hot, cold, temperature, sweat shiver, goose bumps, reproduce, babies, placental, care, milk, breast, milk glands, live birth,

### Physical words

Gas, bubbles, force, lever, machine, ramp, screw, magnet, mirror, image, melt solidify, state, solid, gas, air

### Feeling Words

Happily, sad, miserable, beautiful, feeling, care, like, not like, dislike, fear, frightened, brave, courage

### Senses words

Smell, hear, see, feel, rough, smooth, sloppy, wet, slimy, prickly, sense.

### Weather words

rain, fine, sun, cloudy, hot, cold, chilly, frosty, icy, snowy, humid, clammy, temperature storms, wind, thunder, lightening, dark, gloomy, breezy, rainbow, mizzle, drizzle, heavy rain, light rain, soggy, wet, blowy

### Using word

Every time the child is involved in watching or doing an activity with a science or engineering/technology aspects say words that are relevant to the activity. They may be decorative such as the colour of something or the number of legs for example a dog and then the next dog seen has. They may be action words such as purring, folding, cooking or they may be naming words like dog, plant, insect, machine.

In the activities each section Talking and Doing the initial activity for the youngest children is to for them to hear the words associated with that to which it refers. Without

this language relationship to objects and actions they are hampered in progressing further. Talking to them is the most important start in science and engineering learning.

### Communications from the Child and using technology

Talking and listening about doing science is not only a one-way transmission for adult to child. The child has a voice and opinions about it all. Science is about communicating findings and children usually thoroughly enjoy and instinctively tell an audience about what they have done, what they find exciting and what they think. Communication is not confined to talking at the time of event. Whilst many people do not have access to the latest developments in technology, children can draw what they did. Drawings are expressed mental models and are often used before an event for the child to refit an outcome if they do certain things but more often after an event to try to understand what a child themselves undertook and gleaned from the experience or to try to elect their conceptual development in a topic e.g. Tunnicliffe (2004).

There are two very simple technologies, which are more readily accessible, cameras and tape recorders (which have developed into MP3 players). Children love recording themselves, they can just say what they thought, did and found out to be played back to themselves, to other children who may then be able to replicate their study, as scientists do. Such recordings can be used in the assessment of their progress or played to parents for them to hear direct words from their children. Cameras can be film ones but they do involve the expense of processing. Digital cameras can be a brilliant tool for communication and children can take many many pictures. One 18 month old girl in the back of her grandmother's car was able to use a digital camera and took 75 pictures of things she saw during a relatively short journey.

Young children seem able to work out how to use the technology around them, often modelling actions they have observed adults making. The photographs do not have to be uploaded onto computers necessarily but can be looked at on the viewing screen of the camera. Children can be asked to talk about the photographs and choose perhaps a few to be uploaded and perhaps printed off. Again, such records can be invaluable if you have to keep a developmental profile. Some places fortunate enough to have useful software such as Purple Mash ([www.purplemash.com](http://www.purplemash.com)) a creative online space, or cloud can upload the work of a child into their personal folder. Such resources also enable schools to share the work of a child with their parents or carers. Children in the early years of school very quickly learn to recognise their symbol for their folder and use their individual log in.

Whilst children do have the opportunity to investigate outside in some area which is not as easy and virtual worlds can have their uses. In a way if a child explores a virtual world first, such as those presented in Simple City ([www2simple.com/simplecity](http://www2simple.com/simplecity)) they can have advance orientation to phenomena such as a zoo, farm or park, 3 of the sites that simple city provided, and talk about and unquiet I wonder what? Where? Before they make the visits. This programme is acting as another form of advance organiser, which is



an essential feature of any out of school visits. Using software children can draw their science investigations and observations. Certain software such as Create a story(2simple.com/2cretaeastory) enables the child to draw and animate their drawing, showing an experience of a see saw is the classic example often shown in this programme. There is the facility for the child to be a few words under their drawing and add sounds like a tune as well as their commentary. For a pre writer this is a superb method for having the child develop the art of communicating findings and feeling of science and engineering in their lives. Video cameras can be used in the same way.

Science journals in pre school classrooms are advocated as tools to support not only their learning of science but also of literacy - writing about their experiences, like the 4 year old who found a dead bumble bee and was so excited she rushed into the nursery and wrote that she had found a bee, much to the welcome astonishment of her teacher. She suddenly had relevant personally meaningful content about which she wanted to write and share. Such journals can also be used for assessment, (Brenneman and Louro, 2008).

Making a photo album/ journal (Katz, 2011) of a very young child of photographs of what interested them and what they did from their earliest years and then going back when they're little older and talking about the actions and occasions if they recall it is a very useful novel longitudinal means of recording and communication with emergent sincerity and can give great pleasure to parents, grandparents and others as well as being useful in formal education. It is useful activity to suggest to parents and carers to do with a child at home.

Children can communicate their science investigations through drama without any technologies. I once witnessed young children in rural Sri Lanka show what they had found out about growing seeds through a dramatic dance they had composed which they performed for us.

### Play, talking, doing and learning

Play defines childhood and is so important to optimal development that it has been recognised and protected by the United Nations Commission for Human Rights in article 31, as a right of every child (Department for Education and Skills (Does, 2004). Increasingly society refers to social justice and one aspect, the rights of children, which is the right of the child to play (Alderson, 2000). It is also accepted wisdom that young children learn crucially important social and emotional skills through play and being formally taught at too early an age (Moyle, 1993), does not allow this essential and critical development. These now accepted rights of the child reinforce that children have the right to both play and to structured learning when appropriate. Many practitioners believe in the entitlement to play and a child-centred methodology has emerged (Lancaster and Broadbent, 2003). However, parents may be of the opinion that play is unproductive for the development of their young child believing that formal schoolwork should prevail to develop the learning potential and achievements of their child. It is unfortunate that the word play has many definitions, parents are suspicious of

it Moyles, (1996), such sentiments led to the statement referring to English formal early learning, Two play-aid decades over the closing years of the 20<sup>th</sup> century (Brock et al., 2009). Many parents believe that a formal method leads to better learning even with the youngest children (Blenkin and Kelly, 1996). Thus the historic stigma of play being regarded as frivolous still looms in the minds of a fraction of parents and educators (Blenkin and Kelly, 1996). It is the experience of many educators who have really worked with children that they apparently respond more effectively when curriculum concepts are experienced through play when they later are introduced to the concept in formal learning.

All kinds of play are essential for learning and development, e.g. Moyles (1989), Broadhead (2005). There are various definitions put forward to designate play, for example, role-play/creative play, Physical (Outdoor and indoor) play, free/child initiated play, structured adult-led/initiated play. Spontaneous play is a natural activity according to Sheridan (1990:15) and describes the orderly developmental sequence as: a) Active play; b) exploratory and manipulative play; c) imitative play; d) constructive play or (end product) play; e) make-believe (or pretend) play; and f) games with rules. Moreover the child moves from infant stage using basic sensory and motor equipment towards more sophisticated and creative communication as a toddler and beyond. However, in this sequence the child is according to Sheridan (ibid) dependent on continuing adult encouragement and the provision of suitable toys and other equipment, and the encouragement come through observing and talking to the child, even before they speak, and listening once they verbalise their activities, discoveries and emotions. Children rely on adults to help them by providing the scaffolding in the zone of proximal or potential development (Vygotsky, 1962). Materials activities provided by thoughtful, informed teachers and carers encourage spontaneous play. Play for learning occurs naturally. Furthermore, through planning activities for early learners in their charge the adult is constantly analysing and observing the learning opportunities and its beneficial achievements whilst, making decisions on necessary adult involvement as to how to move the play forward as the individual needs are met for successful learning and development. Thus play is more than just work of children (Broadhead, 2004, pg. 89) it is their self actualization as they recognise themselves as a cognitive being and precede to comprehensively explore their world and their place in it and response to it.

## Health and Safety issues

Check all equipment; do not use items that may hurt the children such as glass, which may break, sharp scissors for example. Eating items is not a good idea unless they are purchased expressly for that purpose and clean utensils are used (no food on the table tops, use clean plates or dry paper napkins and hand washing are scrupulously observed. If you look at moulds have them in a see through container with a firm lid or sealed with cling film for example so that spores of the fungi can not escape to be berated in. Check too if you have animals, particularly mammals, that children are into allergic to them, if some children are you have to discuss action with management. Keeping animals in

class is a valuable activity because it enhances observational skills and can engender attitudes of care and welfare. Mealworms are ideal animals to keep but there are issues with mammals. They live on bran or similar food and need a piece of potato or apple for moisture every so often. If the container is small they do need cleaning every so often and a large holed sieve can be used to separate the substrate, which needs replacing, and the animals. Mealworms develop from an egg into larvae, and then a chrysalis and they then emerge in the adult form as beetles. The eggs are very small to see but you may see some as you clean them out, You can study the whole life story of an insect that undergoes a complete change or metamorphosis to the adult form, as do butterflies and moths, and frogs and other amphibians. Children can feel the power of another living thing on their hand. All you need is a small see through plastic aquarium with a lid or a piece of cling film with a few holes punched stretched across the top. Do take advice from the RSPCA or CLEAPSE\* before keeping other animals. The Association for Science Education publish a book called *Be Safe!* Which contains salutary advice and is a useful reference document. Terrapins for example can carry Salmonella. Children should wash their hands when they have touched animals or been digging in the soil.

### The Ideas of Children

Through their observations and investigations, as well as applying their logic, children do develop ideas about particularly causes of phenomena. Such ideas are often different to those of accepted science. Such alternative explanations or ideas are often referred to as misconceptions or alternative conceptions. They are very real to the children and are often very difficult for adults to change when the child is older, thus these early ideas can form barriers to further learning and understanding (Clement, Brown & Zietsman, 1989). Many of these concepts are not scientifically acceptable and can be extremely resistant to change (Black & Lucas, 1993). For example a four-year-old child had his explanation about why it rains and announced, *It rains because the sun shines on the tops of the clouds and pushes the rain out and it rains down to us.* (Bradley, 1996, p3). The taxonomy of animals used spontaneously by young children such as shown by the children mentioned earlier is not taxonomy at one with that of biology.

The take away message is children need to observe, take part in everyday activities that are science and engineering in the everyday world. They need to hear the words and hear conversations about such phenomena long before they acquire the facility of talking for themselves. These early experiences in these early years are critical in the development of a feel for, and understanding of, science and engineering in their lives and it is important to recognise those activities in the context of the culture in which they occur.

### Organisation of Book

The following 11 chapters deal with the following areas of science.  
Chapter 1 Planning for Early Years science- resources

Biological Science  
Chapter 2 Ourselves  
Chapter 3 Other Animals  
Chapter 4 Plants  
Chapter 5 Other Living Things  
Physical Science  
Chapter 6 Forces  
Chapter 7 Structures  
Chapter 8 Materials  
Chapter 9 Changes  
Environmental Science  
Chapter 10 Built Environment  
Chapter 11 Outside

Each chapter begins with the key words associated with the topic so that if you wish to, you can look them up for further clarity. These Big Ideas sections are designed to refresh your memory about the background science to the topic about which the activities for the children are focused. They are not intended for you to tell the children. These early learners need the hands on experience together with the relevant everyday words and dialogue about them but not the theory. Other teachers can develop that later.

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