

YOUNG CHILDREN'S CONCEPTIONS OF LIVING
AND NON-LIVING OBJECTS:
IMPLICATIONS FOR TEACHING

by

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A THESIS
submitted to the Faculty of Graduate Studies
The University of Manitoba

In Partial Fulfillment of the Requirements
for the Degree

MASTER OF EDUCATION

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Faculty of Education

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A thesis submitted to the Faculty of Graduate Studies of
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ABSTRACT

This study explored the nature of five and six year old children's conceptions of living and non-living objects and identified the effectiveness of implementing a conceptual conflict strategy in promoting conceptual learning.

Information which was used to guide the development of the instructional sequence was gained from interviews conducted with the children. A pre/post research design was followed to examine the effects of the instructional sequence on the modification of children's conceptions of living and non-living objects. The clinical interview and the Interview-About-Instances methods were used to elicit children's ideas in relation to living and non-living as well as determine the effectiveness of the instructional sequence.

The interviews were conducted and the instructional sequence implemented during the months of November and December, 1989. Eight children, four five year olds and four six year olds, were interviewed prior to and following instruction.

The results of the study showed that the children's conceptions of living and non-living changed positively toward a more scientific viewpoint following participation in the instructional sequence. Findings indicated positive change both in children's ability to classify objects on the basis of living and non-living and in the number of correct

classifications made during the Interview-About-Instances. The increased frequency of correct responses and the improved classificatory behaviour were attributed to the effectiveness of the instructional sequence.

The instructional sequence developed for this research study, based on the Constructivist view of learning, involved a four phase approach to promoting conceptual change in relation to the five and six year old children's ideas of living and non-living objects. The instructional sequence included the provision of experiences which elicited and challenged children's existing ideas, enabling the scientific viewpoint to be seen as more intelligible, plausible, and fruitful than the children's own conceptions. The implementation of this approach resulted in the elaboration and modification of children's original ideas toward a more scientific understanding of living and non-living objects.

DEDICATION

To George J. Wurtak
My Inspiration

and

Geoffrey J. Wurtak
My Motivation

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Leslie A. Wurtak

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CHAPTER 1

FRAMEWORK OF THE THESIS

Introduction

The general notion that learning is the result of the interaction between what the student is taught and his/her current ideas and concepts is not original. This notion has been implied, if not stated in different ways by leading figures in cognitive psychology from early Gestalt psychologists to Piaget and onward (Kohler, in Galloway, 1976; Ausubel, 1968). Piaget's more recent studies of causality have perhaps had the greatest impact on the study of the interpretive frameworks students bring to learning situations (Posner, Strike, Hewson, and Gertzog, 1982). However, the educational implications of these interpretive frameworks have been largely ignored by science educators until recently (Osborne and Freyberg, 1985).

During the last decade, there has been a rapid growth of research into students' science conceptions of natural phenomena. Articles documenting the development, content and modification of students' ideas during instruction have appeared extensively in science education journals (Driver,

Guesne, and Tiberghien, 1985; Pines and Novak, 1985). Although this body of research is extensive, it is possible to identify general findings about students' ideas in science. It has been documented (Osborne and Freyberg, 1985) that from an early age, and prior to any teaching and learning of formal science, young children develop ideas and interpretations about the natural phenomena around them. These ideas represent knowledge that has been constructed through both direct experience with the environment and interactions with others. Children, therefore, bring to the learning of science, ideas which are sensible and coherent from their point of view and which have been successful for them in explaining scientific phenomena they have observed. These ideas and interpretations however, differ significantly from the accepted scientific viewpoint and are often resistant to modification or extinction despite formal science instruction (Nussbaum and Novick, 1982).

Simply identifying young children's conceptions and understanding some reasons for their persistence, does not alleviate the problem of children's points of view as obstacles to learning. Educators must help the learner to see the limitations of an existing conception while presenting a new concept which has the capacity to solve problems and to be extended. This new concept, however, must be consistent with what the learner already knows. This awareness of the nature of children's conceptions has led to the generation of

models of conceptual change and indications of how this knowledge might be used in an educational setting.

Statement of the Problem

The purposes of this study were:

- 1) to ascertain the substance of the actual beliefs and concepts about living and non-living objects held by a small group of five and six year old children and
- 2) to promote the elaboration and/or modification of the existing ideas of these children through the implementation of teaching strategies designed to promote conceptual learning.

The study will:

1. ascertain a small group of five and six year old children's existing ideas of living and non-living;
2. determine if there are general patterns in children's ideas related to living and non-living;

3. determine if elaboration and/or modification of children's ideas of 'life' and 'living' have occurred as a result of participation in an instructional sequence designed to promote conceptual change related to living and non-living.

4. determine whether or not specific teaching strategies can promote conceptual change in relation to children's ideas about living and non-living objects.

The specific research questions investigated were as follows:

1. Will five and six year old children spontaneously categorize objects on the basis of living and non-living?

2. What are five and six year old children's beliefs about living and non-living objects?

3. Is there any commonality in young children's conceptions about living and non-living objects and, if so, what patterns can be identified?

4. Are there any differences in conceptions related to living and non-living objects between five and six year old children?

5. Can conceptual learning be enhanced through the development and implementation of an instructional sequence which utilizes conceptual conflict strategies designed to promote conceptual change?

6. Can selected activities presented in an appropriate teaching sequence, promote elaboration of children's ideas of living and non-living objects?

Rationale for the Study

Long before receiving systematic science instruction, young children begin to develop coherent, internally logical conceptual frameworks, based upon their own experiences and interactions, which, to them, are very successful in explaining everyday events (Pope and Gilbert, 1983). Children's descriptions of natural phenomena may seem contradictory, but these ideas seldom seem to present any conflict or concern to the children who advance them. It is not difficult to find evidence that children possess ideas about scientific phenomena which differ from the views held by those in the scientific community. For example, many young children think that the sun cannot shine on a cold winter day,

and that materials dissolved in water have indeed disappeared! Whereas these ideas appear somewhat humorous on the surface, they are more than interesting observations and can constitute obstacles to future learning in science.

The existence of these ideas or beliefs presents a problem for science educators. Research dealing with children's ideas prior to or following science instruction, concluded that students' pre-instructional ideas, when in variance with scientific conceptions, may play an interfering role in the learning of concepts (Nussbaum and Novick, 1982). Thus, it has been noticed that following instruction, children have not modified their ideas despite attempts by the teacher to promote the scientific view and offer counter-evidence (Driver, Guesne, Tiberghien, 1985). Clough and Driver (1986) argued that it may be necessary to take into account the ideas and beliefs children bring to their formal study of science, if these ideas are to be successfully modified by instruction.

A number of studies reporting attempts to promote conceptual change in classroom settings have been undertaken (Champagne et al., 1982; Nussbaum & Novick, 1982). In most cases, studies of this kind have been based on the assumption that the intuitive ideas held by students prior to instruction are both identifiable and stable, and have enough commonality to warrant the development of instructional strategies designed to change them. However, the provision of the scientific view and/or counter-evidence is often not enough to result in a modification in deeply rooted beliefs.

Children must conclude for themselves that their current ideas are limited in their ability to solve problems and explain phenomena. The implications for teaching are clear - if a teacher wishes to encourage children to adopt a "scientific conception", instructional sequences must include the provision of experiences which challenge children's existing ideas, enabling the scientific viewpoint to be seen as more intelligible, plausible, and fruitful than children's own conceptions (Pope and Gilbert, 1983). In this manner, conceptual change may occur.

This study researched the substance of the beliefs and concepts of living and non-living objects held by five and six year old children and attempted to modify these ideas through the implementation of teaching strategies designed to promote conceptual learning. Currently, there exists a severe lack of research on young children's ideas about scientific phenomena. Most of the research has involved the use of adolescent and college aged students. This population is easier to investigate due to the richness of their experiences and their ability to articulate ideas and beliefs. Young children, too, possess a wealth of experiences but these are certainly limited in relation to the experiences of an adult. Children must also overcome linguistic difficulties which present barriers between what is known and the ideas which find expression. Many of the ideas possessed by children are

known intuitively, making it very difficult for young children to articulate their private knowledge.

The lack of research on young children's ideas about natural phenomena is particularly evident in the biological sciences. Much of the research concerning "children's science" has been conducted in the physical science realm, and almost to the exclusion of young children under the age of seven. Osborne (1985), for example, conducted extensive interview and classroom studies on twelve year old students' ideas about electrical currents; similarly, Erickson (1979), investigated the substantive aspects of twelve year old students' thinking about heat and temperature.

Within the biological sciences, results of recent studies have provided an indication of how students understand a range of concepts, including photosynthesis (Wandersee, 1983), living versus non-living (Tamir, Gal-Choppin and Nussimovitz, 1981; Carey, 1985), plants (Bell, 1981), and animal biology (Bell, 1981; Ryman, 1974). Although these studies focus on the unique ways individual learners construct sensible and coherent, though at times idiosyncratic representations of the biological world, most neglect to investigate the views held by primary aged children.

Definition of Terms

concepts - objects, events, situations or properties that possess common criterial attributes and are designated in any given culture by some sign or symbol (Ausubel, Novak and Hanesian, 1968).

accommodation - changing the cognitive structure to meet the requirements of each novel experience.

assimilation - new information linked or related to existing knowledge.

conception - a belief or set of beliefs held by an individual even though they may differ from the beliefs of others.

alternative frameworks - commonly occurring ideas derived from children's attempts to account for regularities in the physical world and which are reinforced by patterns in natural language. These ideas differ significantly from the accepted scientific theory.

misconceptions - metaphors and analogies which represent truly complete systems of explanation but are conceptually wrong.

idea - an attempt to explain a belief.

cognitive structure - concerns the form and organization of an individual's ideas, meanings, concepts and cognitions.

conceptual conflict - recognition by the learner of a problem and his/her inability to solve it with his/her existing conceptions.

discrepant event - an event which creates conflict between existing conceptions and some observed phenomena which the learner cannot explain.

constructivism - the process of constructing or creating a concept which serves as a guideline against objects or people are gauged.

Research Procedures

Procedure 1.

To elicit and document five and six year old children's beliefs and concepts of living and non-living objects through the use of informal discussion and individual interviews;

Procedure 2.

To develop clinical interview questions, to determine if children spontaneously classify objects on the basis of living and non-living;

Procedure 3.

To use the Interview-About-Instances technique designed to elicit children's conceptions of living and non-living objects;

Procedure 4.

To determine if general patterns in children's ideas of living and non-living are apparent;

Procedure 5.

To determine if a discrepancy exists between children's conceptions of living and non-living objects and the specific content and teaching sequence recommended in the Manitoba Science Curriculum;

Procedure 6.

To implement the use of specific teaching strategies designed to challenge and modify children's existing ideas about living and non-living objects;

Procedure 7.

To develop and sequence science activities which take into account children's existing ideas of living and non-living and promote conceptual conflict;

Procedure 8.

To conduct individual interviews to determine if modification of original ideas has occurred;

Procedure 9.

To determine the effectiveness of the teaching strategies and instructional sequence in promoting conceptual change through the use of pre- and post-instruction interviews.

Educational Significance of the Problem

This study resulted in the identification of the various conceptions of living and non-living held by a small number of five and six year old children, as well as the development of an instructional sequence designed to promote conceptual learning.

The results of this research study may be deemed significant in that they identified a range of concepts associated with the words 'living' and 'non-living'. Further, the results indicated the effectiveness of utilizing an

instructional program which confronted children with inconsistencies between new scientific evidence or ideas and their existing conceptions. Ascertaining children's ideas and interpretations prior to instruction should form the basis from which appropriate science activities are developed. Science activities should not simply involve children in activity, but also expose children's beliefs and create situations which encourage children to discuss and confront the stated scientific viewpoint.

The results of this study could be used to provide curriculum developers with better understandings of children's conceptual development in science and teaching strategies to help young children learn more effectively.

Limitations of the Study

Limitation 1

The sample size of the randomly-selected children who participated in pre- and post-instruction interviews was limited to eight. The five and six year old children were selected from the same community and school population. This small and restricted sample may limit the generalizability of the results.

Limitation 2

The conveyance of children's beliefs about living and non-living objects were limited by their ability to verbally articulate thoughts and ideas to the researcher.

Limitation 3

The responses to the interview questions were limited by the ability of the children to understand the questions.

Limitation 4

The implications derived from the study were limited to the procedures employed and the questions (pictures) which made up the pre- and post-instruction interviews.

Summary

Young children develop ideas and interpretations about natural phenomena long before they receive formal instruction in science. These ideas represent knowledge that has been constructed through direct experience with the environment and interactions with others. Despite formal instruction and the presentation of counter-evidence, children's ideas are often robust and resistant to change and modification. When developing instructional sequences, teachers need to be aware of the current ideas held by children in relation to the specific science concepts being taught. This sensitivity to

both the children's and the scientific viewpoint, may enable teachers to provide experiences which cause children to reflect on their own views, explore the differing conceptions of others, and confront the scientific viewpoint presented.

This chapter has presented an introduction to the research study. In the following chapter, a survey of literature works pertinent to this study is given. A review of the relevant learning theories is presented together with a description of the concept 'living'. Also presented in Chapter 2 is a brief discussion of the Clinical Interview as a method of evaluation.

CHAPTER 2
LITERATURE REVIEW

Structure of the Literature Review

In order to provide a knowledge base relating to the field of this study, the review of the literature focuses on six areas:

1. A brief overview of the relevant aspects of theories of learning.
2. A brief description of Piagetian Theory of Cognitive Development.
3. A description of the Constructivist view of learning.
4. A review of previous studies which focus on children's ideas in science and the implications of these ideas on subsequent learning.

5. A brief discussion of the clinical interview method of data collection and evaluation, which was used in this study and a discussion of the Interview-About-Instances technique as a method of evaluation.
6. A description of the concepts of 'life' and 'living' in relation to the distinction between the scientific viewpoint and those ideas held by children.

Theories of Learning

How people learn and the conditions under which they learn are questions that have been investigated by several generations of educational psychologists. Research on learning has generated several theories of learning: association theories, cognitive theory and information-processing theory (Klausmeier, 1985). What follows is a brief description of the relevant aspects of these theories in relation to this study.

1- association theories - Two association theories are conditioning and observational learning. Through the process of classical conditioning, a previously neutral stimulus, through repeated presentation with an uncontrolled stimulus, becomes a conditioned stimulus and elicits a conditioned response. In other words, when two or more events are

associated closely in time and place, they become learned. By contrast, in operant conditioning, when a response is followed by either a positive reinforcer or the removal of a negative reinforcer, the response that was made immediately prior to the reinforcer is strengthened (Klausmeier, 1985).

Observational learning is based on the assumption that behaviour is learned by observing and imitating the behaviour of others when the observed behaviours are being reinforced. According to Bandura, the degree to which learners will observe and model desirable behaviours can be explained in terms of four processes (Klausmeier, 1985):

- 1- attention - the ability to notice the significant features of the modelled behaviour
- 2- retention - encoding the observed behaviours into memory
- 3- reproduction - transforming the internal representation of the observed behaviour into appropriate actions
- 4- reinforcement -
 - i) direct reinforcement - the learner imitates observed behaviour and is reinforced immediately
 - ii) vicarious reinforcement - the observer anticipates a reinforcer for behaviour in a given way.

2- cognitive theory - Cognitive theorists advocated that significant aspects of learning can be more completely

understood if inferences are made about what goes on in the minds of learners. Concept learning represents one conceptual framework from which to explore the learning process.

A concept, according to Klausmeier (1975) can be defined as "ordered information about the properties of one or more things -objects, events, or processes - that enable any particular thing or class of things to be differentiated from and related to other things or classes of things". The word 'concept' can be used to designate both mental constructs of individuals and also identifiable public entities. Concepts as personal constructs refer to the attainment of concepts according to each individual's unique learning experiences and maturational pattern. A concept as a public entity corresponds to the meaning of the word that names the concept. Thus, the meanings of words comprise the socially accepted, or public, concepts of groups of persons who speak the same language.

It has been suggested that children develop class concepts partly from experience of many examples, from which they abstract criteria of class membership, and partly from verbal definitions (Gagne, 1977). Concrete concepts are learned on the basis of encounters with class instances that can be directly sensed by the learner. Since collections of objects may vary widely in appearance, the learner must respond to the objects in terms of some common abstract

property. A concept has been acquired when the learner can identify a novel instance of the concept (Gagne, 1977).

Some concepts can be learned by direct interaction with the learner's environment, while others must be learned by definition. According to Gagne (1977), a defined concept is a rule that classifies objects or events. The rule represents one or more objects and the relation among these objects. e.g. saucer: a dish (object) for holding (relation) a cup (object). In contrast to concrete concepts, defined concepts cannot be readily acquired simply by presentation of a variety of instances and non-instances whose characteristics can be directly perceived by the learner. Instead, the component concepts of the definition are typically communicated to the learner. This means that the learner is reminded by these verbal cues, of the objects and the relation which comprise the new concept to be learned (Gagne, 1977). Similarly, Klausmeier (1985) suggested a concept has been learned at the formal level when the learner can identify examples of the concept, give the name of the concept, discriminate and name the defining attributes of the concept, and provide a socially accepted definition of the concept.

3- information-processing - Many cognitive psychologists espouse a theoretical framework known as information processing. In this framework, mental events are described in terms of transformations of information from input

(stimulus) to output (response). Information is received by sense receptors and these receptors send electrochemical impulses to the sensory register in the central nervous system (Gagne, E., 1985). All incoming stimuli can be accommodated in the sensory register but only for a brief period of time. Through a process called "selective perception", a small portion of the incoming information is attended to and represented for further processing in short-term memory.

Information in the STM decays completely and is permanently lost if not rehearsed and further processed within twenty seconds (Gagne, 1985). If information is attended to, the transformed information goes to the working memory. The working memory governs the flow of information to the long-term memory. With the appropriate elaboration, rehearsal, and integration of information previously stored in the short-term memory, information then moves to the long-term memory for storage and later retrieval (Gagne, E., 1985).

Piagetian Theory of Cognitive Development

Piagetian theory indicated that cognitive development from birth to maturity progresses through four clearly delineated stages. Certain cognitive structures are specified and make possible the child's progression from one stage to the next (Klausmeier, 1985). An assumption underlying

Piaget's theory is that individuals continuously interact with their environments. Each interaction has two adaptive aspects: assimilation and accommodation (Klausmeier, 1985). Assimilation is the process whereby the learner incorporates new experiences into the existing cognitive structure. According to Good and Brophy (1980), assimilation is the process by which previously established schemas are automatically activated to deal with a specific stimulus or situation. Accommodation implies changing the cognitive structure to meet the requirements of each novel experience (Klausmeier, 1985). Through the process of assimilating and accommodating, the cognitive system itself changes and cognitive development occurs.

The process of intellectual development begins with a pattern of thinking which is characteristic with one of the four invariant stages of cognitive development. New information which is inconsistent with what is already known and cannot be readily assimilated, creates conflict and causes disequilibrium (Rampaul, 1983). The child attempts to resolve the conflict through modification of existing cognitive structure. The complementary processes of assimilation and accommodation operate simultaneously to enable the child to reach a new state of balance or equilibrium (Rampaul, 1983).

Constructivist View of Learning

A fundamental notion in current perspectives in cognitive psychology is that individuals construct their knowledge through physical and social interaction. This perspective represents the constructivist view of learning (Scott, 1987). Constructivism as a theoretical perspective, proposed that understanding results from the ongoing construction of meaning; a process that demands the vigorous participation of the learner as he/she records experience in light of previously learned knowledge (Strike and Posner, in West and Pines, 1985).

A constructivist view of learning perceived children as active learners who come to the learning situation already possessing ideas about natural phenomena, which they use to make sense of everyday experiences. This knowledge has been constructed through experience with the physical environment and through social interaction. Through these direct experiences with the physical world and through formal intuition, children evolve sets of personal theories in order to explain events. Learning, therefore, involves children in not only adopting new ideas by simply adding to and extending existing concepts, but also in modifying or abandoning their pre-existing concepts. Such a process is one in which learners actively make sense of their world by constructing

links between perceptions and existing knowledge (Scott, 1987).

Learning begins not with the experience itself, but with selective attention to specific and relevant aspects of the experience (Osborne and Wittrock, 1983). Selective attention dictates perceptions and is itself dependent upon the store of images, episodes and skills already possessed by the learner. To construct meanings, the learner generates links between sensory information and those aspects of stored memory considered relevant. New meanings are then tested against sensory experiences and long-term memory. The assimilation and ultimately the subsumption of new meanings depends on their consistency with those concepts previously stored in long-term memory and the capacity of a competing view to solve problems currently unresolved by existing conceptions. Accommodation or subsumption does not represent a rapid or initially radical change. Rather it is a gradual adjustment of ideas which lay the groundwork for further adjustments. The end result is a substantive reorganization or change in one's concepts (Posner, Strike, Hewson and Gertzog, 1982).

Previous Studies of Children's Ideas in Science

The research literature concerning children's science conceptions has seen rapid growth during the past two decades.

Although this body of research is extensive, similarities in the nature of the research indicate two identifiable trends: research which gives an overview of what is currently known about children's thinking in a particular topic area, and case studies describing how the ideas held by children can change as a result of specific instruction.

Studies of Children's Ideas in Science

Much of the research undertaken in the area of children's science has explored children's understandings of particular concepts. Whereas there is great diversity in the topics explored, there seems to be identifiable trends in the nature of children's ideas. Driver et al (1985), Erickson (1979), and Novak and Gowin (1984) expounded the belief that children's ideas are personal and idiosyncratic in nature and influence the manner in which new information is processed and organized. Although children's ideas reflect the nature of their interactions with the environment and with others, there appears to be general patterns in the ideas expressed by children in relation to particular concepts. These general patterns of ideas, referred to by a variety of terms in the literature such as alternative frameworks (Driver, 1985), conceptual inventories (Erickson, 1979), and knowledge category systems (Novak and Gowin, 1984), suggest that there exists relatively stable patterns of beliefs in children. The

presence of stable patterns of beliefs may be attributed to the high degree of shared or common experiences among children.

Another trend in the nature of children's ideas is that their beliefs and interpretations differ significantly from the accepted scientific viewpoint and are often resistant to modification despite formal science instruction (Nussbaum and Novick, 1982). The robust and persistent nature of children's ideas has been documented by several researchers (Driver and Clough, 1986; Posner, Strike, Hewson and Gertzog, 1982). The persistence of children's ideas may be developmental in nature in that the content is inconsistent with what the child already knows and cannot be readily assimilated, or it may be due to the success of these ideas in explaining everyday phenomena. These ideas, when in variance with scientific concepts, may play an interfering role in the subsequent learning of science concepts (Nussbaum and Novick, 1982; Brumby, 1982).

Studies Promoting Conceptual Learning

Interest in the persistence of children's intuitive ideas despite instruction has led to the generation of specific teaching strategies designed to promote conceptual learning. Studies of this kind have been based on the assumption that the intuitive ideas held by children prior to instruction are

both identifiable and stable (Driver, Guesne, and Tiberghien, 1985), and possess enough commonality to warrant the development of instructional strategies designed to change them.

Although there exists diversity in the specific instructional strategies reported in the research, two general notions which dominate the literature are: the elicitation and identification of patterns or trends in children's thinking, and the importance of confronting children with inconsistencies between new evidence or ideas and their existing conceptions.

Posner, Strike, Hewson and Gertzog (1982), in developing a view of how children's current ideas interact with new, incompatible ideas, have identified conditions which promote conceptual change. According to the researchers, a new conception was unlikely to displace an old one unless the old idea lacked the capacity to solve problems, and a new intelligible conception was available that resolved the difficulty. The learner must first view an existing conception with some dissatisfaction before considering a new idea. The new concept must appear to have the capacity to solve problems and to be extended, and it must be consistent with what the learner already knows.

Nussbaum and Novick (1982) generally agreed that accommodation or conceptual change began with a recognition by the learner of a problem and the inability to solve it with

existing conceptions. Children need help in developing an awareness of the inconsistency between new ideas and their existing frameworks. According to Nussbaum and Novick, the first crucial step in an instructional strategy for facilitating accommodation was the use of an "exposing event" capable of eliciting children's ideas. The purpose of the exposing event was to assist children to articulate and understand their beliefs. After children became aware of their existing ideas, a problem situation was introduced through a discrepant event. The role of the problem situation was to create conceptual conflict which would lead to the accommodation of the new idea.

Driver et al (1985) suggested a three phase approach to promoting conceptual change, beginning with an orientation activity in which children's attention and interest in the topic are aroused. During the next phase, children reviewed their own ideas and discussed the views expressed by others. This elicitation phase was followed by a restructuring phase which involved the use of several guidelines for promoting conceptual change. While the strategies are diverse, there are similarities among the strategies expounded by Driver and several other researchers. Similar to the research of Posner, Strike, Hewson and Gertzog (1982), Driver advocated confronting children with the limitations of their thinking through the use of activities which present counter-evidence or discrepant events. Driver further suggested the need to

help children construct alternative conceptions when prior ideas are incompatible with the scientific view being presented. Children's prior ideas are elicited and discussed in light of the differing scientific view. The discontinuity in the children's ideas and that of scientists needs to be recognized in the teaching and an alternative conception presented with practical experience to support it.

Osborne and Freyberg (1985) also advocated building on children's intuitive ideas to assist in the modification of children's firmly-held ideas to accommodate scientifically accepted views. The researchers suggested that science instruction should result in the clarification of children's existing ideas, modification of these views toward the current scientific view and, consolidation of the scientific view within the background experience and values of the children.

Driver et al (1985) suggested the use of discrepant events to stimulate children to reflect upon their ideas and the situation. Where ideas are inconsistent, socratic questioning may help children to appreciate the lack of consistency in their thinking and to reconstruct their ideas in a more coherent way. To assist with the consolidation of new ideas, children should have opportunities to 'test out' the range and limits of applicability of the modified idea in a variety of situations.

According to Novak and Gowin (1984), the central elements in the structure of knowledge and the construction of meaning are concepts and the propositions composed of concepts. The researchers advocated the need for students and teachers to move toward shared meanings of science concepts. In order to achieve these shared meanings, Novak and Gowin (1984) have developed two educational tools: concept mapping and Knowledge Vee diagramming. A concept map, an external representation of the relevant concepts and propositions known by the learner, revealed the nature of linkages between concepts thus making explicit the learner's prior knowledge.

The "Knowledge Vee" was developed to further understand the process of knowledge construction (Novak and Gowin, 1984). As new knowledge was acquired, three elements - concepts, objects/events, and records of objects/events - come together. The Knowledge Vee allowed teachers to help students recognize the objects/events observed, relate these observations to what is already known, and record the relationship among existing and new information.

Implications for Science Teaching

Over the past decade, a large body of research has described numerous examples of children's widely held beliefs about natural phenomena. These beliefs or alternative

frameworks are more than interesting observations, for the importance of these frameworks derives from the central role beliefs play in perception, comprehension, problem solving and learning. Alternative frameworks represent a directing and interpretative structure within which learners construct new knowledge from information available in memory and the environment. Thus, children bring to the study of science ideas which are intelligible and coherent from their point of view and which have been successful for them in explaining scientific phenomena they have observed. These ideas however, differ from and often conflict with the contemporary scientific viewpoint and are resistant to modification despite formal science instruction (Driver, Guesne and Tiberghien, 1985). The persistence of these ideas and interpretations present a problem to science educators. Research findings by Erickson (1979) and Brumby (1982) suggested that older students who have been exposed to years of formal science instruction on a given topic, still associated that concept with meanings which had been constructed during students' early experiences with the phenomenon rather than meanings developed in the classroom. In other words, despite conventional teaching, students tended not to modify their ideas in the presence of counter-evidence and chose to interpret information in terms of their prior ideas.

Research has led to the generation of teaching strategies designed to promote conceptual change and indications of how

these strategies might be useful in helping children modify existing ideas in order for subject matter to be understood. According to Driver et al (1985), children have the tendency to interpret new situations in terms of what is already known, thus reinforcing their prior conceptions. An exception to this is when a learner is unable to interpret a situation in a coherent way. There may be alternative, possibly conflicting interpretations which the learner can give, or the situation may be such that the learner is unable to construct any meaningful interpretation at all. It is this situation that may provide the necessary conditions for conceptual change, for learners are confronted with the limitations of their existing conceptions. To integrate new concepts, children may have to modify the organization of their ideas in a radical way. This kind of learning according to Driver, Guesne and Tiberghien, does not occur frequently for children tend not to adopt new ideas or change their existing ideas radically. They may, however, be encouraged to use accepted scientific ideas in a progressively wider range of situations over an extended period of time.

Effective implementation of science instruction requires the utilization of teaching strategies which promote conceptual learning. Conventional science instruction appears to produce little change in the initial conceptions held by children. Such an adherence to an earlier view may inhibit the transition to a more scientific viewpoint (Gilbert and

Watts, 1983). When developing instructional sequences, there needs to be the provision of experiences which elicit and challenge children's ideas, thus enabling the scientific viewpoint to be seen as more intelligible than the children's own conceptions (Pope and Gilbert, 1983).

The Clinical Interview as a Method of Assessment

Conventional assessment techniques treat children's responses as either correct or incorrect and have not revealed the conceptual problems encountered by children in their attempt to understand science concepts. In adopting a constructivist view of learning, it is recognized that children do not simply exchange an incorrect set of ideas for the scientific view. Children's ideas tend to develop over an extended period of time. Thus, assessment techniques are needed which monitor and give credit for the progress a child has made.

The clinical interview was described and used by Piaget six decades ago (Piaget, 1929 in Pines, Novak, Posner and VanKirk, 1978). It was Piaget who first introduced this method for the purpose of studying cognitive development in children. Two different formats of Piagetian interviews are evident: those that are flexible, following the child's thought wherever it leads, and those that are inflexible and

have been more or less standardized (Pines, Novak, Posner and VanKirk, 1978). Between these extremes were varying degrees of flexibility, along somewhat of a continuum.

Clinical interview techniques are used to probe children's cognitive structure and to reveal existing relevant prior knowledge. According to White (in West and Pines, 1985), interviews represent the most subtle, fine-grained techniques for investigating cognitive structure and the process of learning. Several researchers regard the clinical interview as a relatively superior evaluation measure, especially for young children (Pines and Novak, 1985). Further, Pines, Novak, Posner and VanKirk (1978) suggested that the most meaningful representations of cognitive structure can be obtained from a clinical interview.

Although techniques vary, most interview formats retained the basic approach of a conversation with one child around the stimulus of some material or phenomena (Osborne and Gilbert, 1980; Pines and Novak, 1985). The interviewer attempted to combine the spontaneous dialogue of the child with the use of probing questions to check the basis of the child's reasoning. The interview was generally characterized at first by open-ended questions and acceptance of all responses, following the child's reasoning wherever it may lead. Later, the interviewer may probe more specifically to encourage elaboration of earlier responses by having the child give reasons for his/her inferences or predictions. Provided the

child is able to articulate ideas and is provoked to think, the interview method does give the interviewer the greatest chance to reveal the child's reasoning about a given concept (Sutton, 1982).

Within the literature, there appeared two general purposes for describing cognitive structure; one was for research purposes and the other was instructionally oriented. The former involved information about what children know and the extent to which they are making progress toward some instructional goal or objective (Pines and Novak, 1985; Erickson, 1979; Gilbert, Watts and Osborne, 1985). The latter concern involved issues that have to do with the manner in which educators can or should use information about the knowledge their students possess, in order to make instructional decisions (Clough and Driver, 1986; Brumby, 1981; Posner, Strike, Hewson and Gertzog, 1982).

For instructional purposes, clinical interviews can be used to probe children's cognitive structure to elicit statements regarding specific concepts before and after instruction. These statements are then rewritten to reflect general patterns in children's ideas which contain the range of understanding children hold for specific concepts (Pines and Novak, 1985). Such analysis of interview data permits the examination of specific changes occurring in the child's cognitive structure as a result of specific instruction.

The Interview-About-Instances (I.A.I.) technique, developed by Gilbert, Watts and Osborne (1985) to elicit children's personal meanings for words, was used by the researcher to ascertain young children's ideas of 'living'. The I.A.I. technique consisted of a tape-recorded discussion between the researcher and a child, using a deck of cards which focused on various meanings associated with a single word. Each card consisted of a picture of an example or non-example of the applications of the word. The child classified each picture as an example or non-example and reasons for each classification were sought. The method revealed the range of understandings associated with the word. Gilbert, Watts and Osborne have used the I.A.I. technique to investigate student's idiosyncratic meanings for words.

Concept of 'Life' and 'Living'

There appears to be no single definition of the concept 'life'. The traditional seven characteristics of living organisms are growth, reproduction, external respiration, nutrition, excretion, irritability and locomotion (Brumby, 1982). However, the microscope has enabled the identification of cells as the 'units' of life, while the development of sophisticated biochemical techniques resulted in specification of more precise characteristics, the presence of:

- 1- organic constituents - DNA, functional protein, glucose, and
- 2- energy transformation - cellular respiration (Brumby, 1981).

According to Steen (1971, p. 256), life is defined as:

"the sum of the properties of protoplasm, namely metabolism, growth, irritability, movement and reproduction as manifested by a cell, group of cells, or an organism by which such is distinguished from inorganic or non-living matter; the functional activities of an organism".

The traditional and more recent characteristics can be combined to form an operational definition of the concept of life e.g., what to look for in an object in order to decide whether it is alive, dead, or non-living. Bell (1981), suggested that a person is said to have a scientifically acceptable concept of 'living' if he/she can distinguish between instances and non-instances of the concept, as would the biologist. In addition, if he/she can give reasons for the choice of instances and non-instances which are similar to those of a biologist, then there exists a scientific rationale behind the concept.

Investigations of children's conceptions of life began in the early twentieth century. Piaget (1977), using the 'clinical' interview technique, conducted interviews to determine the development of the 'life' concept in children. Piaget observed a trend in children to see inanimate objects as living things possessing feelings and sensations. This trend was referred to as 'childhood animism'. According to Piaget, children derived ideas of causality from cases in which they themselves intentionally make things happen (Carey, 1985) e.g. the sun is hot because it wants to keep people warm.

Based on Piaget's interview data, five stages which characterize the development of the 'life' concept were identified (in Carey, 1985):

Stage 0 - No concept; random judgements, or inconsistent or irrelevant justifications.

Stage 1 - Activity; an object demonstrating movement or the ability to produce noise is considered to be alive.

Stage 2 - Movement; life is identified by movement.

Stage 3 - Autonomous movement; objects which exhibit spontaneous movement are alive.

Stage 4 - Adult concept; only living things are identified as being alive.

Similar to the findings of Piaget, Looft and Bartz (1969, in Tamir, Gal-Choppin and Nussinovitz, 1981) concluded that animistic notions exist among children of all ages and persist into adulthood. A major replication of Piaget's results was conducted by Laurendeau and Pinard (1962 in Carey, 1985). They tested five hundred subjects between the ages of four and twelve on a standard version of the clinical interview. Their data essentially agreed with Piaget's except that they found no evidence for a distinction between Stages 1 and 2. Carey (1985) replicated the work of Laurendeau and Pinard (1962, in Carey, 1985) using ten children at each of three ages 4, 7, and 10. As in the Piagetian procedure standardized by Laurendeau and Pinard, children were asked if they knew what it meant for something to be alive. After answering, they were asked to name things that were alive and things that were not alive. Children were then shown a series of pictures and asked to indicate whether the object in the picture was alive or not. Carey's (1985) investigation yielded similar results to those reported by Laurendeau and Pinard. She concluded that the phenomena of judging inanimate objects alive, was remarkably stable.

Although Carey's (1985) results indicated that the phenomena of childhood animism was robust, her data did not actually support Piaget's (and Laurendeau and Pinard's) characterization of stages. Several distinctions between the investigations of Carey (1985), Piaget (1929) and Laurendeau and Pinard (1962 in Carey, 1985) are as follows:

- 1- Unlike Piaget and Laurendeau and Pinard, Carey suggested the possibility of the attribution of life to inanimate objects reflected semantic rather than conceptual problems. In other words, it could not be assumed that the word 'alive' had a direct pipeline to children's concept of life. Even if children had a concept of life, 'alive' may have other meanings for them.

- 2- Laurendeau and Pinard did not distinguish between two types of anthropomorphic traits. According to Carey, growth and reproduction were highly relevant to the biological concept of living things whereas others, like facial features and body parts, were relevant to people and animals. The second type of anthropomorphic traits used as a justification for 'living' was absent from Piaget's stages.

- 3- Piaget suggested that children produced patterns of judgements and justifications that were consistent with

single-criterion definitions. Carey, however, indicated that most children produce several types of justifications for their judgements. These results provide no evidence for single-criterion definitions of life.

4- Piaget attributed the disappearance of animistic attributions to the growing distinction between intentional and mechanical causation. Carey believed it to be the child's developing biological knowledge which allowed for the distinction between living and non-living things (alive - dead; alive - inanimate).

Tamir, Gal-Choppin and Nussinovitz (1981), investigated the prevalence of animistic notions and the meanings of these notions among intermediate and junior high students. Findings did not clearly support Piaget's stage theory. The persistence of animistic notions may not have been observed and subsequently not documented due to the age of the students. Results indicated that eight percent of the intermediate and junior high school students believed that moveable inanimates possessed sensitivity. No students indicated the existence of consciousness in inanimate objects. This finding was supported by Brumby (1981) in that first year medical students did not identify 'consciousness' as an attribute of living things.

An interesting finding of the Tamir et al (1981) study, was that children related different meanings to the concept 'living'. For many of the children the life of man and animals was perceived differently from that of plants, embryos or inanimate objects. However, children had difficulty explaining these different meanings of life. Not surprisingly, findings indicated that movement was the most popular indicator for distinguishing between 'alive' and 'not alive'. Approximately forty percent of the students classified eggs and seeds as not alive. Students appeared confused by living things in a state of dormancy. While thirty-six percent of the students realized that living organisms originate from other living organisms, most were unable to explain this relationship.

Lawson (1987), when interpreting the work of Tamir, Gal-Choppin, & Nussinovitz (1981), suggested that the study revealed no evidence for deeply rooted alternative frameworks. However, Tamir et al (1981) did indicate general trends in children's ideas of 'living' and the criteria by which they form classifications of living and non-living objects. Based on his own research using a sample size of three children, aged six, nine and ten, Lawson concluded that children come to the learning of concepts in the life sciences as 'blank slates'. In contrast to the views of several other researchers (Wandersee, Mintzes & Arnaudin, 1987; Carey, 1985), Lawson (1989) believed that children hold

few personally derived and deeply-rooted alternative conceptions because the relevant phenomena exist on a microscopic level with which children have little direct experience. Lawson further suggested that the relative complexity of biological concepts and the more indirect relationship to common experience does not provide children with a common core of shared experience upon which to develop intuitive ideas. This view expressed by this researcher is in opposition to view of Driver and Erickson (1983) and Mintzes (1989). Young children, according the Driver and Erickson (1983), generally possess a meaningful learning set and attempt to incorporate new knowledge into the existing relevant cognitive structure.

Mintzes (1989) disagreed with Lawson's (1989) conclusion that unlike in the physical sciences, little evidence existed to support the view that the knowledge acquisition process in biology consisted of naive theory construction and cognitive conflict. According to Mintzes (1989), children construct meanings from virtually all forms of personal experience. What differentiates the physical and biological sciences was not the existence or non-existence of naive theories but rather the timing of conceptual change.

Mintzes (1989) suggested that alternative conceptions in the physical sciences develop in response to relatively simple natural phenomena (a floating object). Replacing these naive theories required major restructuring which

involved the accommodation of fundamentally new, abstract defined concepts (density, displacement). In contrast, Mintzes (1989) suggested that elaboration of children's 'intuitive biology' generally occurred in the school environment and was accompanied by the emergence of a new repertoire of concepts which reflected a more 'scientific' viewpoint. The results of Carey's (1985) investigation of young children's conceptions of 'alive' supported the notion of the existence of naive theories in the biological sciences and the acquisition of the adult conception of 'living thing' by age ten.

Summary

This review of related literature helped to generate the theoretical framework for this research study. The various studies (Osborne and Freyberg, 1985; Driver, Guesne and Tiberghien, 1985) indicated that from an early age and prior to any teaching and learning of formal science, young children develop ideas about the natural phenomena which surrounds them. These studies indicated the need to utilize teaching strategies which allow children to modify and clarify their concepts thus progressively replacing current ideas with a more scientific viewpoint. This study acknowledged these conclusions and an instructional sequence

was developed to promote the elaboration and/or modification of children's existing ideas of living and non-living objects through the implementation of teaching strategies designed to promote conceptual learning. The following chapter presents the details of the administration of the Clinical Interview and the Interview-About-Instances methods as well as the development of the instructional sequence.

CHAPTER 3

RESEARCH PROCEDURES

This study concerned itself with two major issues. Initially, the substance of the beliefs and concepts of living and non-living objects held by five and six year old children was researched. Secondly, it was determined if elaboration and/or modification of children's ideas of 'living' occurred as a result of participation in an instructional sequence designed to promote conceptual change.

Selection of Subjects

The subjects for this study were five and six year old children from a large elementary school in a suburb of Winnipeg. Four children were randomly selected from each of the following classes: the Kindergarten afternoon class and the Grade One class. Thus, eight children in total were randomly selected to participate in the study. Subjects were selected using a table of random numbers. By using the method of random sampling, each member of the student population had an equal and independent chance of being selected for the sample. Based on guidelines of theoretical sampling it was assumed that this method would result in a sample which was

unbiased and representative of the student population. Once randomly selected, participation in the study was voluntary.

Four girls and four boys, with a mean age five years nine months (age range five years one month to six years five months), participated in the study. The children were middle class, from both blue and white collar families. Approximately 12% of the children were from minority families. Prior to the study, the subjects were enrolled in public school from three to thirteen months. The subjects did not receive formal instruction on the science topic "Living and Non-living Objects".

Justification of Methodology

For many years, attempts to describe (measure) students' cognitive knowledge have employed standard psychometric procedures. With this approach, the assumption was generally made that knowledge existed as subject-matter disciplines rather than psychological entities. Whereas the psychometric approach has proven to be very effective for many situations, there are limitations to this assumption and the ability of traditional psychometric procedures to capture the complexity of certain types of knowledge (cognitive structure). As a result, more appropriate procedures for representing knowledge

and describing the cognitive structure of students were developed.

Over recent years a wide range of procedures have been developed to investigate children's ideas about the world in which they live. Many of these parallel the studies conducted by Piaget in that they involve individual interviews with a focus on natural phenomena. Although the interview format may vary, the interview process involved devising specific interview events and objects as well as questions that make it possible to observe regularities in children's responses (Novak and Gowin, 1984).

Research studies designed to probe children's cognitive structures to reveal existing relevant prior knowledge have been making use of various interview techniques. Interviews, according to White (in West and Pines, 1985), represent the most subtle, fine-grained techniques for investigating cognitive structure and are a legitimate means for collecting data. Examples are found in the work of Pines (1977), Osborne and Gilbert (1980), Erickson (1979), and Clough and Driver (1986). The interview techniques reveal insights into how individuals store, recall and apply information in a variety of situations. Thus, interviews enable an investigation of the learning process.

There is an inherent bias in any clinical interview in terms of the extent that the interview protocol will

adequately sample the totality of possible ideas a child can generate from his/her idiosyncratic cognitive structure. However, the problem of validity exists with any evaluation tool and most researchers regard the clinical interview as a relatively superior evaluation measure, especially for young children (Pines and Novak, 1985).

Development of Clinical Interview Questions

Questions were devised to encourage the five and six year old children to classify various living and non-living objects according to self-determined criteria. The questions were designed to be general and open-ended in nature to allow children to respond freely. The researcher refrained from guiding children's responses. Following the children's initial response, probes for clarification were used to obtain more specific and in-depth information.

The various living and non-living objects used were as follows: pop-up puppet, squeeze toy, car, rock, plant, fish, dead leaves, egg, gyroscope, seeds and bulbs, dead frog, celery, mosquito larvae, mosquitoes, mealworms and bingo chips.

To encourage active manipulation of the objects and expression of ideas, the researcher posed the following questions:

1- "Can you find objects that are the same and put them together?"

2- "Can you tell me why you decided to put these objects together?"

3- "Can you tell me how the objects in this group are different from the other objects?"

Development of "Interview-About-Instances" Questions

The Interview-About-Instances (I.A.I.) technique was developed by Gilbert, Watts and Osborne (1985) to elicit students' idiosyncratic meanings for words commonly used in science. The I.A.I. technique consists of a tape-recorded discussion between the researcher and a student, using a deck of cards and focusing on the applications of a single word. A card consists of a line drawing of a situation which may, or may not, represent an example of the application of the word. Whatever the student's response, reasons for the classification of the word as an example or non-example are sought. This method reveals the breadth and manner of use of the chosen word over a range of situations through careful and deliberate selection of examples and non-examples.

To ensure that the interview technique would be appropriate for use with young children, the researcher made several modifications to the original technique developed by Gilbert, Watts and Osborne (1985). The similarities and differences between the I.A.I technique and the modified I.A.I. technique developed by the researcher are indicated in Figure 3.1. The I.A.I. technique began with a brief rapport building session just prior to the commencement of the interview itself. It was felt that when working with young children, more time must be spent in direct interaction with children to ensure that children feel comfortable with and trust the researcher. Therefore, prior to data collection, the researcher spent approximately two days in each of the participating classrooms in an attempt to get acquainted with the children participating in the study.

Another deviation from the original I.A.I. technique was the provision of an exploratory play period. Since the interview technique depended upon the ability of the subjects to articulate their thoughts and ideas clearly, the researcher provided children with an opportunity to discuss their ideas with others. Various living and non-living objects were displayed as a stimulus to encourage active investigation of the objects and informal discussion with the researcher and the other children.

Table 3.1 Modified Interview-About-Instances Technique

<u>I.A.I. Technique</u>	<u>Modified I.A.I. Technique</u>
personal	rapport building exploratory play open-ended questions picture identification
presentation of cards	presentation of cards
key questions	key questions
follow-up questions	follow-up questions
final definition	final definition
transcription	transcription
analysis	analysis

Following a brief rapport building phase, the I.A.I. technique began with the presentation of cards and the commencement of the interview. The researcher, in an attempt to reduce the children's uncertainty about the instances and non-instances depicted on the cards, allowed for picture identification. Together, the child and the researcher viewed and identified each picture in the sequence in which they were to be presented. Thus, when the child encountered the card again during the interview, uncertainty was reduced and the child could then focus specifically on the classification task.

The card selection and presentation was conducted as outlined by Gilbert, Watts and Osborne (1985). However, the

amount of 'researcher dialogue' was reduced and the questions simplified. Brumby (1981) investigated children's conceptions of animals using the I.A.I. technique and asked the following questions:

- 1- "Is the cat an animal?"
- 2- "What tells you that?"

Although the simplicity of the questions appealed to the researcher, it was felt that difficulties could arise due to the nature of the concept being explored. For example, when presenting the picture of the boy, the researcher would say, "Is the boy living?" Confusion could result because the boy was represented by a symbol or a picture which was indeed not real or living. However, the picture represented a 'living' thing. Thus, to alleviate confusion, the researcher structured the key questions as follows:

- 1- "Is this a picture of a living thing?"
- 2- "How do you know?"

The modified I.A.I. interview technique was used to investigate the range of concepts five and six year old children associated with the word 'living'. Pre- and post-instruction interviews were conducted to enable an investigation of each child's conceptual learning. The technique consisted of the use of twenty cards (contents listed on p. 3.12) depicting examples and non-examples of the

concept 'living'. This directive method of eliciting children's ideas consisted of a mixture of open and closed questions. The interview was structured as follows:

1- introduction - "I am interested in children's ideas about objects that are living and not living. I would like to talk to you about your meaning of the word living. First I'll show you a picture and then we will talk about it".

2- key questions for each card - "Is this a picture of a living thing?" "How do you know?"

3- follow up questions for each card - "How do you know this is a living thing?" "Can you explain to me why you think that?"

"Can you tell me more about that?"

4- final question - "Thank you for telling me about your meaning of the word living. Just to finish, I wonder if you could describe to me in your own words what a living thing is to you.... What a non-living thing is to you."

Development of Interview-About-Instances Cards

Gilbert, Watts and Osborne (1985) outlined in great detail the process of the I.A.I. card preparation. Since the

selection of pictures used in the I.A.I. could influence the outcome of the interview, the researcher employed the eight step procedure as stated by Gilbert, Watts and Osborne.

1-scientist's meaning of living - according to Steen (1971), life is defined as "the sum of the properties of protoplasm, namely metabolism, growth, irritability, movement and reproduction as manifested by a cell, group of cells, or an organism by which such is distinguished from inorganic or non-living matter; the functional activities of an organism".

In order for the definition to be more appropriate for use with young children, it was more desirable to view 'living' in terms of combinations of features or characteristics. Therefore, from the above stated definition, living organisms are complex systems which require an energy supply, respond to the environment, exchange gasses with the environment, grow, reproduce and move. The last three features in themselves do not represent characteristics specific to living organisms. Many non-living objects are capable of locomotion and crystals, for example, reproduce and grow.

2- analysis of scientific view

- connotative meaning of living: alive, not dead; possessing the properties of life; animate.

- denotative meaning of living: actual, real, not a toy or picture; full of power, energy, or importance, not obsolete or exhausted; glowing; charged; moving or imparting motion; fully responsive.

3- criteria attributes of 'living' - the seven traditional characteristics of living organisms are: growth, reproduction, external respiration, nutrition, excretion, irritability, locomotion (Brumby, 1982). As stated in the Manitoba Science Curriculum, the characteristics of living objects are: nutrition, growth, death, reproduction.

4- non-criteria attributes of 'living' - continuity of life; some non-living objects were previously living things; there is a distinction between living and dead and non-living and dead; many living organisms cannot complete the life cycle without human intervention; the environment provides basic necessities to sustain life; dormancy.

5- sources of linguistic confusion -

1- synonyms: alive, vibrant, glowing, existing, vivacious, lively, activity, consciousness, fullness, sensitivity, warmth, real.

2- antonyms: dead, decay, end, inactivity, insensitivity, non-existent, lifeless, cold.

6- sources of invalid use of scientific meaning of living - the word 'lively' to refer to inanimate objects; 'live' as an adjective to refer to real things; 'live' as a verb to refer to subsistence; to conduct oneself in a certain manner; to survive; to reside.

7- producing cards -

1- examples: all criterial attributes and some non-criterial attributes: bird, cat, worm, boy, tree, egg, mushroom, flower, seed, fish.

2- non-examples: one or more criterial attributes absent and some non-criterial attributes included: rock, car, jet, spinning top, fire, jack-in-a-box, sun, television, water, clouds.

8- ordering cards - the deck contained twenty cards; ten examples and ten non-examples. Cards 1-8 depicted examples; cards 9-12 depicted non-examples; cards 13-20 depicted more difficult instances of examples and non-examples.

The modified "Interview-About-Instances" (I.A.I.) method was pilot-tested using three children from the morning Kindergarten class. The purpose of the pilot-test was to address issues related to instrument validity. Responses to the questions were audiotaped and analyzed for instrument deficiencies such as unclear wording, inadequate selection of

depicted examples and non-examples, poor sequencing of the cards, negative subject reaction, length of interview and potential problems in analyzing the interview data. Content validity of the I.A.I. method was assured by the group nature of the preparation of the cards (Roscoe, 1975). Three experts within the area of science education (biology professor, science consultant, science methods teacher) were asked to review the card selection to determine if the pictures met the criteria for "living" as previously defined.

The pre- and post-instruction interviews were administered by the researcher to each child in a private setting at the school. The duration of each interview was approximately forty minutes. During the interviews confidentiality was ensured. The interviews were audiotaped using a tape recorder and later transcribed into written form. Following completion of all interviews, pre- and post-instruction data were analyzed.

Method

Rapport Building

Prior to the commencement of the research project, the researcher spent time in each participating classroom before attempting to collect data from the children. The time was spent in direct interaction with the children. The purpose

of this rapport building session was to provide an opportunity for children in both classrooms to become familiar and comfortable with the researcher. A level of trust needed to be established, for the interviews were not conducted in the classroom but rather in a private location in the school.

Provision of Exploratory Play Period

An exploratory play period was provided prior to the pre-instruction interviews. This period of exploration allowed children to become familiar with a variety of living and non-living objects by encouraging their investigative play with the materials provided. Informal discussion among the children and the researcher focused children's attention on the various attributes of the objects although there was no formal discussion of living and non-living. It was hoped that during this period, children would begin to express openly their ideas about the objects.

The following objects were used during the exploratory play period: pop-up puppet, squeeze toy, car, rock, plant, fish, dead leaves, egg, snake, moss, gyroscope, gerbils, seeds, dead frog, mosquito larvae and eggs, dead moth, mosquitoes and mealworms. The objects selected represented examples and non-examples of living objects, most of which were familiar to young children. The purpose of the collection of objects was to stimulate interest in the science topic and encourage dialogue among children.

To encourage active investigation of the objects and expression of ideas, the researcher posed open-ended questions similar to the ones to be used during the clinical interview. The questions asked were as follows:

- "Can you find something interesting about these objects?"

- "Are there objects that you could group together?"

- "Why have you placed these objects together?"

- "Can you tell me if there is anything the same/different about the objects you have put together?"

During the exploratory play period, children from the Kindergarten and the Grade One class participated as one group. This exploratory play period was conducted one day prior to the commencement of the individual interviews to allow children an opportunity to reflect on the ideas expressed and the observations made during exploration. The exploratory play period was videotaped to allow for later analysis.

Implementation of Pre-instruction Interview

The pre-instruction interview was comprised of two components: 1- clinical interview; 2- Interview-About-Instances technique. During the clinical interview, the researcher and the child sat at a table containing the same living and non-living objects as were handled by the child

during the exploratory play period. The objects served as a stimulus for manipulation and discussion. The purpose for using the familiar materials was to encourage the child to classify the objects according to self-determined criteria and articulate the reason for the classification. At this point there was no focus on the child's ideas of living and non-living. The researcher attempted to determine if children spontaneously categorize objects on the basis of living and non-living.

The Interview-About-Instances (I.A.I.) technique represented a more directive method of interviewing. This technique was used to ascertain the substance of the beliefs and concepts of living and non-living held by the five and six year old children. As this interview technique directly followed the use of the open-ended questions, children were still able to view the examples of living and non-living objects. During the interview, children were presented a sequence of pictures and asked to identify examples and non-examples of living objects and provide a rationale for the classification. At the conclusion of the interview, children were asked to provide a definition of "living" and "non-living" in their own words. This definition was recorded on chart paper along with the child's name and was used by the child for self-evaluation. At no time during the interview did the researcher respond to the content of the child's

responses or provide feedback as to the classification employed by the child and the reasons for the classification.

Compilation of Data Resulting From Pre-Instruction Interviews

The starting point in the analysis of the interview data was the transcript of the audiotape. Transcription of the tape was done shortly after each interview was completed and was conducted in two distinct phases as suggested by Gilbert, Watts and Osborne (1985). First, the words and noises were recorded verbatim. The tape was then replayed, entering intonation, pauses, and comments to the transcription.

The clinical interview was analyzed to reveal specifically the nature of the investigation of objects engaged in by each child. The researcher then determined the general patterns in classificatory behaviour which emerged. Analysis of the child's responses to the three open ended questions revealed each child's ability to articulate his/her actions and ideas in relation to the objects manipulated. The child's ability to identify and discuss novel and common attributes among objects was also determined.

The classificatory behaviour and associated articulated ideas of each child following the Interview-About-Instances was compiled. General patterns in children's classification of examples and non-examples of living things were identified. Following an analysis of the audiotape, the transcript was carefully examined for expressions and statements that

represented evidence of children's beliefs about living and non-living objects. Key ideas in the explanations of children were transcribed to a single statement. The statements were then analyzed for the emergence of major ideas or common criteria used in the explanations (Brumby, 1982).

Small Group Discussion

Following the completion of the individual interviews, children had the opportunity to discuss their ideas of living and non-living objects with the other children participating in the study. Children also had the opportunity to "test out" these ideas on the various living and non-living materials provided. The informal small group discussion, which involved the four five year old children and four six year old children, was researcher-facilitated, and focused on the following stimulus questions:

- "What is a living thing and how do you know?"
- "How do you know that an object is non-living?"
- "What does it mean to you when you hear the word non-living?"
- "What can you tell me about living things?"
- "What are the differences between objects that are living and objects that are not living?"

The purpose of the discussion was to expose children to the range of ideas expressed about living and non-living objects. Children were encouraged to re-examine their original ideas in light of the other expressed views. Children's definition of 'living' and 'non-living' were recorded on chart paper and compared to their original definition stated during the interview.

Development of Instructional Sequence

The five and six year old children's ideas about living and non-living objects formed the basis of the development of the instructional sequence. The teaching sequence began where the children were, building upon their expressed ideas and progressed through developmentally appropriate activities designed to promote conceptual change. The instructional sequence consisted of activities and teaching strategies which:

- 1- put children in situations where their interpretations were contradicted
- 2- allowed children to ask themselves questions about the expressed interpretations of living and non-living
- 3- caused discussion among children and the researcher.

The instructional sequence developed for this research study was based on the Constructivist view of learning. Fundamental to this view of learning is the notion that individuals construct their knowledge through physical and social interaction. Through direct experiences with the physical world and through formal intuition, children evolve sets of personal theories in order to explain the phenomena which surrounds them. Learning involves children in not only adopting new ideas by simply adding to and extending existing concepts, but also in modifying or abandoning their pre-existing concepts.

The instructional sequence involved a four phase approach to promoting conceptual change in relation to the five and six year old children's ideas of living and non-living objects. The instructional sequence began with an orientation activity in which children's attention and interest in living and non-living objects were aroused. The orientation activity allowed children to become familiar with a variety of living and non-living objects while engaging in informal discussion. Through the use of open-ended questions, the researcher encouraged the children to engage in investigative play and share their observations with the other children. During the next phase, children reviewed their own ideas of living and non-living expressed during the pre-instruction I.A.I. interviews, and were exposed to the views of the other children. This elicitation phase took the form of a modified group discussion

where the researcher encouraged the children to express their ideas in relation to living and non-living objects. Various living and non-living objects were displayed to stimulate discussion and probe children's conceptions of living and non-living objects. The elicitation phase was followed by a restructuring phase which involved the use of the conceptual conflict strategy. Through the presentation of discrepant events and counter-evidence, the researcher attempted to assist children in the modification of their original ideas of living and non-living. The final phase, consolidation, involved the development of the scientific view being presented.

The restructuring and consolidation phases were comprised of four activities, one to focus on each characteristic of living organisms as stated in the Manitoba Science Curriculum. The activities selected attempted to create conceptual conflict by presenting a discrepant event or contradictory information to the expressed ideas of the children. The four activities selected for inclusion in the instructional sequence were designed to help children focus on the criterial attributes of living things and help children understand the need to examine the range of attributes which differentiate living and non-living objects. The activities were as follows:

activity 1. growth - Through the use of pictures, children sequenced the growth of human beings, a household pet, and an insect. For the insect, children illustrated the development of mosquitoes, mealworms or butterflies, with which all of the children were familiar. The children then discussed the similarities and differences among the various living things. Children's attention was focused on the fact that the insect pupae does not resemble the adult insect. The researcher and the children also discussed if the pupae was living or non-living. The final activity involved the making of crystals using silver nitrate and observing the growth of crystals. Discussion of crystals as living or non-living objects followed. In preparation for further activities, a variety of seeds was placed in baggies for sprouting. Children's seeds were placed in a warm location while the 'experimental' seeds were placed in the freezer. The children also attempted to sprout a variety of non-living objects - stones, bingo chips, marbles.

activity 2. nutrition - The children investigated their nutritional needs as well as the needs of a household pet and a plant. Children inferred the consequences of not providing for the nutritional needs of plants. Investigations were conducted to determine the

consequences of not providing for the nutritional needs of plants. The results of the investigations were generalized to human beings and animals. To contradict intuitive ideas, a celery stock and a white carnation were placed in a container of food colouring. Children observed the changes in the flower and vegetable over several days. Discussion of the necessity of placing these objects in water if they are non-living followed.

activity 3. locomotion - Children participated in rigorous activity and then enjoyed a resting phase. Discussion of the different types of movement followed the resting phase. Children then observed the snakes and discussed the movement observed. Children also observed the gerbils and discussed the movement observed. Various non-living objects which move - pop-up puppet, toy car, gyroscope, spinning top - were displayed. The children and the researcher then discussed the movement of these objects and how it differed from the movement of living objects.

activity 4. life cycles - i) Using pictures, children observed and discussed the development of human life. Through the use of books and slides, children observed and discussed the hatching of a duckling. Using the book entitled 'The Apple Tree' and an apple, the researcher

facilitated a discussion which focused on the apple as part of a living thing. Children examined the seeds and apple sections. Discussion focused on what might happen if the seeds were planted. As a follow-up to the previous day's activities, children examined their seeds to determine if sprouting had occurred. Children also examined the seeds in the fridge as well as the non-living objects to determine if sprouting has occurred. Children then discussed their observations.

ii) Children had the opportunity to discuss the differences and similarities between objects which were dead and those which were non-living. Children also explored the concept of dormancy in animals and plants and contrasted the differences between organisms in a state of dormancy and organisms which were dead.

activity 5. consolidation - Using three pieces of construction paper, the researcher on pasted pictures representing living, non-living, and once-living (dead) objects (adult, car, fallen leaves). The classification word was then printed under each picture. A display of objects was made using living things - plant, sprouting seeds, mosquito larvae; non-living things - ball, shell, egg beater; and some once-living things - dried flowers, fallen leaves, dead frog, dead butterfly. Children were

to classify the objects provided and give an explanation for the classification. Children made their own summary sheet by folding construction paper in three and labelling each section with one of the following titles: living, once-living, non-living. Children illustrated their own examples.

Children followed-up on their on-going investigations which consisted of examining the sprouted seeds as well as the carnation and the celery experiment. Each child then articulated his/her current ideas of living and non-living which was recorded on chart paper. These ideas were examined in light of the original expressed views.

Throughout the instructional sequence, it was imperative that each activity began with a focus on people as living things, followed by a focus on animals and finally plants as living organisms. The learning proceeded from that which children were most familiar -an understanding of themselves - to concepts which they were least familiar. Further, it was important that children developed an awareness of the commonalities among living things.

Implementation of Instructional Sequence

The exact nature and substance of the science activities were determined following the analysis of the individual

interviews. General patterns in the children's ideas of living and non-living objects which emerged as a result of such analysis formed the structure of the teaching sequence. All activities selected attempted to present the 'scientist's view' of life or living, thus helping children construct an alternative framework. Each of the selected activities attempted to promote conceptual conflict through the presentation of a discrepant event or contradictory evidence to the children's existing ideas.

The instructional sequence, involving the participation of both the five and six year old children, was one week in duration, with each session designed not to exceed forty minutes. The science activities were conducted by the researcher in a private location in the school. Throughout the duration of the instructional sequence, children were encouraged to articulate their ideas about living and non-living objects and challenge the views expressed by others. Current ideas of living and non-living were recorded on chart paper and children were encouraged to reflect on any modifications of their original ideas.

The classroom teachers had no specific responsibilities in relation to the gathering of data or the teaching of activities. However, there was an understanding that no formal science teaching on the topic of living and non-living objects occur prior to the completion of the study.

Implementation of Post-Instruction Interview

Post-instruction interviews commenced the day following the completion of the instructional sequence. The researcher interviewed the eight children throughout the day to ensure that the learning experiences were easily recalled. The post-instruction interview was comprised of two components: 1- clinical interview; 2- Interview-About-Instances technique. During the clinical interview, the child was asked three open ended questions similar to the three posed during the pre-instruction interview. The child had the opportunity to respond to the questions and manipulate the objects displayed. The questions asked were as follows:

- 1- "Can you find objects that are the same and group them together? Why do you think these objects belong together?"
- 2- "What is the same about the objects you have grouped together?"
- 3- "Why do you think the objects in this group are different from the objects you placed in another group?"

The Interview-About-Instances technique was conducted to investigate the range of concepts currently associated with the words 'living' and 'non-living'. The procedure for conducting the post-instruction interview was the same as stated for the pre-instruction interview. At the completion of the interview, each child's definition of living and non-

living was once again recorded on chart paper. The researcher discussed informally with the child any modification of original ideas.

Compilation of Data Resulting From Post-Instruction Interviews

Transcription of the tape was done following the completion of each interview and was done in two distinct phases as suggested by Gilbert, Watts and Osborne (1985). First, the words and noises were recorded verbatim. The tape was then replayed, entering intonation, pauses, and comments. All procedures for the post-instruction interview were the same as for the pre-instruction interview.

Method of Analysis and Results Presentation

Once the transcriptions obtained from the pre- and post-instruction interviews were complete, the researcher imposed a structure on the transcripts by identifying and separating the discreet utterances made. Gilbert, Watts and Osborne (1985) have identified five categories which are concerned with different functions and types of talk in the interview. The researcher focused on three of these categories 1- Card; 2- Concept; 3- Framework. The two other types of talk identified by Gilbert, Watts and Osborne, personal and task, appeared to have little to do with the expressed ideas of the

children but focused on personal information discussed informally during the rapport building phase. The three categories used were:

1- Card - the function of the 'card' category was to focus the child's attention on the content of the card, to what they know generally about living and non-living, and then to their underlying beliefs about living and non-living objects. Within this category, the researcher attempted to separate the observations and general knowledge about living and non-living, from the children's underlying beliefs. The type of talk expected to emerge was a response to the details or aspects of a particular card, as well as evidence of the range of individual responses to the concept of living and non-living objects.

2- Concept - this category consisted of explicit talk that generalized between the various cards presented; for example, defining the terms living and non-living, giving examples of living and non-living objects, and making statements about a general concept of 'life'. It was this talk that indicated the particular conception of living and non-living held by the children.

3- Framework - this category referred to the child's wide range of ideas of living and non-living objects from outside the cards to substantiate their conceptions. It included talk that expanded the conceptual framework of ideas, as well as talk that alluded to projections and speculations concerning the pictures depicted on the cards.

In order to analyze the research, the main points of reference were the comparison between the points of view and the interpretations of the children before and after the instructional sequence. This comparison allowed for the illustration of the differing conceptual development of each child in relation to his/her expressed views and understandings of the terms living and non-living.

Data were also analyzed to identify general trends and patterns in children's ideas related to living and non-living. Transcripts were carefully examined for expressions and statements that represented evidence of children's beliefs about living and non-living objects. Key ideas in the explanations of children were transcribed to a single statement. The statement was then analyzed for the emergence of major ideas or common criteria used in the children's explanations.

Children's beliefs about living and non-living objects were presented to reveal the private knowledge held by each

child and the public knowledge shared by the children. The case studies focused on each child's conceptual development in relation to living and non-living objects prior to and following instruction. Analysis of the case study data allowed for the identification of general trends in children's conceptions of living and non-living.

Summary

The procedures used for conducting interviews to ascertain young children's ideas about living and non-living objects have been presented in this chapter. Children's expressed ideas formed the basis for the development of the instructional sequence designed to promote conceptual learning. The procedures used for the collection and analysis of data have also been outlined, with specific findings and subsequent analysis of findings to be presented in Chapter Four.

CHAPTER FOUR

PRESENTATION AND INTERPRETATION OF DATA

This chapter consists of a description and discussion of the data which was collected through the research procedures, basically consisting of the administration of the Clinical Interview and the Interview-About-Instances technique both before and following instruction. It is organized into 5 sections. The first section is concerned with the observations made during the exploratory play period. The second section identifies and describes the general trends in children's ideas expressed during the pre- and post-instruction interviews. The section entitled 'Case Studies' consists of detailed descriptions of children's conceptions of living and non-living prior to and following instruction, while the fourth section examines the general ideas expressed in relation to living and non-living objects. The final section postulates the effectiveness of the instructional sequence developed for the study.

The specific research questions investigated during the study were as follows:

1. Will five and six year old children spontaneously categorize objects on the basis of living and non-living?
2. What are five and six year old children's beliefs about living and non-living objects?
3. Is there any commonality in young children's conceptions about living and non-living objects and, if so, what patterns can be identified?
4. Are there any differences in conceptions related to living and non-living objects between five and six year old children?
5. Can conceptual learning be enhanced through the development and implementation of an instructional sequence which utilizes conceptual conflict strategies designed to promote conceptual change?
6. Can selected activities presented in an appropriate teaching sequence, promote elaboration of children's ideas of living and non-living objects?

Responses to the research questions are contained within the various chapter sections. Questions focusing on young children's ability to spontaneously classify objects as living

or non-living are answered in the section entitled 'General Ideas Expressed In Relation To Living and Non-living' as well as the section entitled 'Case Studies' which indicate the classification system employed by each child during the Clinical Interview. Responses to questions which focus on identifiable patterns in children's expressed ideas about living and non-living objects, and differences in the conceptions of five and six year old children are also provided in the section entitled 'General Ideas Expressed In Relation to Living and Non-living'. Five and six year old children's beliefs about living and non-living objects are documented in the Case Studies. Research questions directed at the enhancement of conceptual learning and the instructional sequence are answered in the section entitled 'Effectiveness of the Instructional Sequence'.

Presentation and Interpretation of Exploratory Play Data

An exploratory play period was provided prior to the commencement of the pre-instruction interviews. The purpose of the exploration period was twofold: to allow children to become familiar with a variety of living and non-living objects by encouraging investigative play with the materials provided, and encouraging children to openly express their

ideas in relation to the objects presented and their personal experiences that helped shape their ideas.

During exploratory play, the four five year old children and the four six year old children participated as one group. The play period, which was thirty minutes in duration, was conducted one day prior to the commencement of the individual interviews to allow children to reflect on the ideas expressed and the observations made during this exploration. The exploratory play period was videotaped to assist in the analysis of the investigative play.

The following objects, displayed on a table, were used during exploratory play: pop-up puppet, squeeze toy, car, rock, plant, fish, dead leaves, egg, snake, moss, gyroscope, gerbils, seeds, dead frog, mosquito larvae and eggs, dead moth, mosquitoes and mealworms. The objects selected represented examples and non-examples of living objects, most of which were familiar to children. The purpose of the collection of objects was to stimulate interest in the science topic and encourage informal discussion among children.

To encourage active investigation of the objects and the expression of ideas, the researcher posed the following open ended questions:

- "Can you find something interesting about these objects?"

- "Are there objects that you could group together?"

As indicated by the nature of the questions, the researcher focused the children's attention on the various attributes of the objects presented. However, there was no formal discussion of living and non-living objects.

During the exploratory play period all children moved around the table as they handled objects. Seven of the eight children interacted with others and became involved in informal discussion as they manipulated objects. One child manipulated objects on her own without talking to the other children. The children tended to move about the table in groups. One child's interest would encourage others to interact with the same object. Initially, the girls tended to handle the objects located close to them rather than moving to an object of interest. Three of the four boys explored many of the objects on the table and expressed their ideas openly.

- "Oh look. The beetle is upside down"!

- "What's this? It looks like sand. They are frogs. They look like and move like tadpoles". (mosquito larvae)

- "I don't know what this is. It's tree stuff. I've seen it at the farm. It's at the lake. It looks like plants

from the sea or grass. I've seen it on the ground. Sometimes it's on trees". (moss)

Although no reference was made to objects as to whether they were living or non-living, the children noticed two objects which were dead - the frog and the moth. Discussion about the frog occurred between two boys. "Is this a live frog? No, it's dead". The children were particularly interested in how the frog died. One of the same boys discovered the dead moth. When questioned how he knew the moth was dead he replied, "It's wings are broken". Most of the children were interested in the snakes for a brief period of time. "It's not moving. Is the snake real"? In reply, one of the boys indicated that snakes did not have hearts because they were reptiles. He concluded that the snake was not a living thing.

Children handled or observed all the objects displayed with the exception of the plant. The children were involved in more active manipulation and/or observation of objects that moved (gerbils, gyroscope, fish) or objects with which they were less familiar (mosquito larvae, moss).

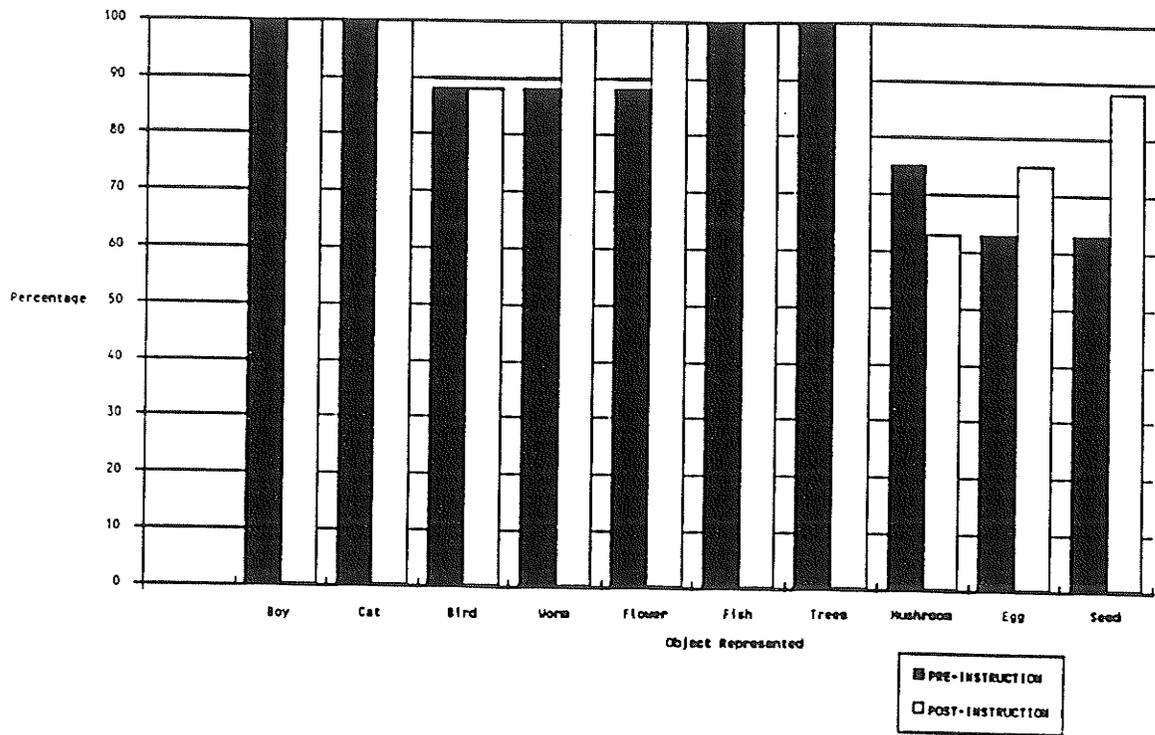
When asked to group similar objects, the children focused on the attributes of colour, shape, texture, identification and location. None of the children spontaneously categorized the objects on the basis of living and non-living.

General Trends in Children's Ideas Expressed During
the Pre- and Post-Instruction I.A.I. Interviews

The Interview-About-Instances technique was used to investigate the range of concepts five and six year old children associate with the words 'living' and 'non-living'. The technique consisted of the use of twenty cards depicting examples and non-examples of the concept 'living'. Children classified each card as an example of a living or non-living object and reasons for the classification were sought by the researcher. The I.A.I. method was used prior to and following instruction to determine if modification and/or elaboration of initial ideas occurred as a result of participation in the instructional sequence.

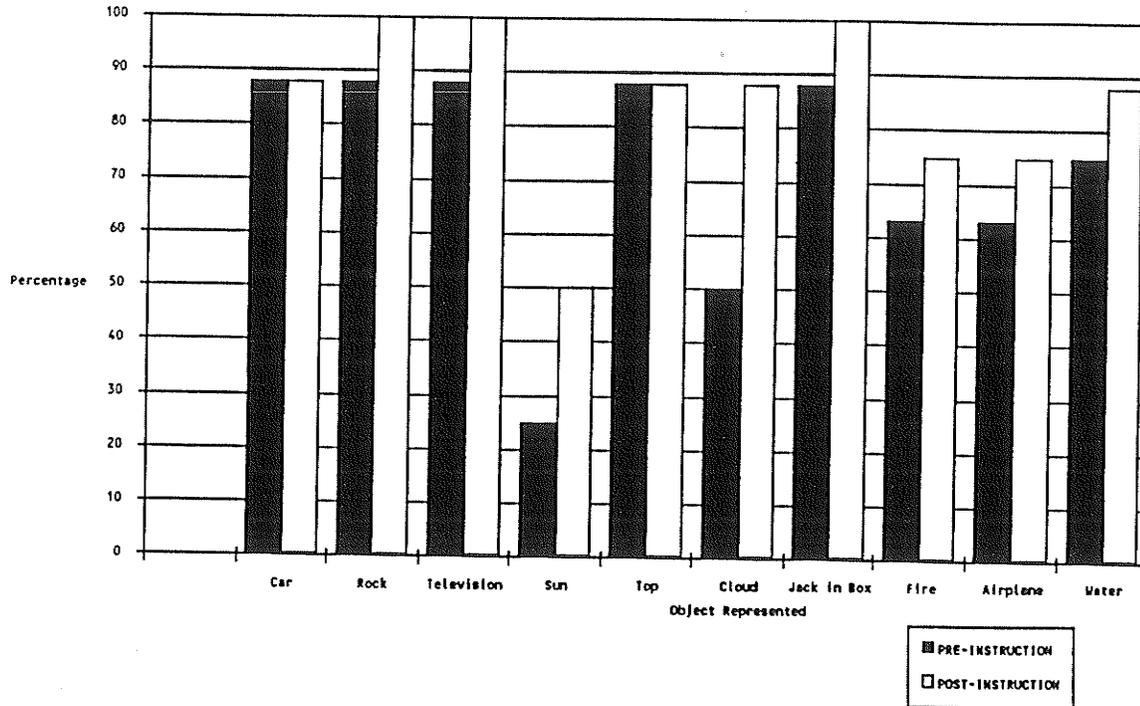
Children generally experienced less difficulty identifying living objects than non-living objects as indicated in Figures 4.1 and 4.2. Further, it was easier for children to identify living objects with which they were most familiar when compared to those objects with which they appeared to have limited experience.

Figure 4.1 Percentage of Children Correctly Classifying Objects as Living



It was most evident (Figure 4.2) during the pre-instruction interview, that children had difficulty classifying 'natural' non-living objects - sun, fire, clouds. These objects sustain life through the provision of warmth and moisture and are also capable of movement. Thus, children tended to identify these objects as living things.

Figure 4.2 Percentage of Children Correctly Classifying Objects as Non-Living



More children classified most of the pictures correctly during the post-instruction interview as indicated in Table 4.1. For three of the pictures presented (bird, car, top), seven of the eight children classified these pictures correctly during both the pre-and post-instruction interview. The same child for all three cards classified incorrectly both times.

On one occasion, more children classified a picture correctly during the pre-instruction interview than during the post-instruction interview as indicated in Figure 4.1. The concept of the mushroom as non-living object was difficult for children to modify in spite of teaching, probably due to children's limited experience with mushrooms ("mushrooms are on pizza and in spaghetti") and the fact that they are edible. Children appeared disturbed by the suggestion that people would eat living things - 'You eat mushrooms'. You don't eat something alive.' Thus, several children concluded the mushroom was non-living.

It was evident (Figures 4.1, 4.2 and Table 4.1) that the number of correct classifications increased during the post-instruction interview. Since children were given no feedback as to the nature of their classifications during the pre-instruction interview, the increased frequency of correct responses may be attributed to participation in the instructional sequence.

The most difficult picture to classify was the sun. As indicated in Figure 4.2, only four children correctly classified the sun as an example of a non-living object during the post-instruction interview.

Table 4.1 Percentage of Children Correctly Classifying
Living and Non-Living Objects

	Object	Pre-Instruction	Post-Instruction
Living Objects	Boy	100	100
	Cat	100	100
	Bird	88	88
	Worm	88	100
	Flower	88	100
	Fish	100	100
	Trees	100	100
	Mushroom	75	63
	Egg	63	75
	Seed	63	88
Non-Living Objects	Car	88	88
	Rock	88	100
	Television	88	100
	Sun	25	50
	Top	88	88
	Cloud	50	88
	Jack in Box	88	100
	Fire	63	75
	Airplane	63	75
	Water	75	88

Case Studies

Case Study A

Personal Characteristics and Background Information

Subject A, a female, was five years two months at the time of the study. Initially, she was a little reserved but appeared interested in the activities. Subject A actively participated in the instructional sequence both through the completion of tasks and in informal discussion. With probing, she was able to successfully articulate her ideas about living and non-living objects. Prior to her participation in the study, she had received no formal instruction in science.

Pre- and Post-Instruction Clinical Interviews

The pre- and post-instruction interviews were comprised of two components: 1- clinical interview; 2- Interview-About-Instances technique. During the clinical interview, the researcher and the child sat at a table containing the following living and non-living objects: pop-up puppet, squeeze toy, car, rock, plant, fish, dead leaves, egg, gyroscope, seeds, dead frog, celery, mosquito larvae, mosquitoes, bulb, mealworms and bingo chips. The child was encouraged to classify the objects according to self-determined criteria and articulate the reason for the classification.

During the pre-instruction clinical interview, Subject A grouped the mealworms and mosquitoes and indicated that both were bugs and capable of movement. She also classified the bulb and the seeds, indicating that both were 'from the summertime'. Subject A did not classify the remaining objects.

During the post-instruction clinical interview, Subject A classified ten of the objects into three distinct groups. Initially she grouped the fish, leaves, seeds and mosquitoes together as objects which were living. The second group comprised of the frog, egg and celery which she identified as dead. The third group included the bingo chips, squeeze toy and puppet which she identified as non-living.

Subject A demonstrated the ability to use classification systems during both the pre- and post-instruction clinical interviews. She went beyond the common attributes of colour, shape and size to classify on the basis of identification and function. Although no reference was made to living and non-living objects in the pre-instruction classification, Subject A solely classified on this basis during the post-instruction classification and clearly demonstrated an understanding of the classification system and the language used.

General Patterns of Ideas Expressed During Pre- and Post-Instruction I.A.I. Interviews

Using the Interview-About-Instances technique, Subject A was presented twenty pictures each depicting an example or non-example of a living thing. She classified each picture and then provided a rationale for the classification. Table 4.2 highlights Subject A's ideas of living and non-living expressed during the pre- and post-instruction interviews.

Subject A applied her knowledge consistently throughout the interviews and the instructional sequence. There was evidence to suggest that Subject A strengthened and extended her ideas of living and non-living objects.

Based on the frequency of response, the researcher compared the main ideas about living and non-living expressed by Subject A during the Interview-About-Instances, with the definitions provided by Subject A when asked by the researcher. They are:

Pre-Instruction Ideas and Definitions

Living: movement, growth, nutritional needs, makes things grow.

Definition of living: living things grow, need food and move.

Table 4.2 Interview-About-Instances, Subject A

Living Characteristics	Interview	
	Pre-Instruction	Post-Instruction
	Frequency of response	Frequency of response
movement	4	5
growth	4	6
food	2	3
makes thing grow	2	
water	1	8
in ground	1	
shines	1	
lets rain out	1	
talk/noise		2
warmth		2
sun		1
die		1
makes things warm		1

Non-living Characteristics	Interview	
	Pre-Instruction	Post-Instruction
	Frequency of response	Frequency of response
no self movement	4	7
no food	3	5
no growth	2	1
toy	2	
you cut it	1	
no water	1	7
eat it	1	
throw in garbage	1	
chick in it	1	
no talk/noise		8
no warmth		1
no sleep		1

Non-living: no self movement, no nutritional needs, no growth, are toys.

Definition of non-living: non-living things can't eat and can't grow.

Post-Instruction Ideas and Definitions

Living: needs water, grows, moves, needs food, warmth, and capable of noise production.

Definition of living: Living things move, grow, talk (sometimes), needs water, milk and food.

Once living: things that were once living and once could grow but they died.

Non-living: can't talk, no self movement, doesn't require water or food.

Definition of non-living: doesn't grow, doesn't move, doesn't need food or warmth. They were never alive.

General Patterns in Expressed Ideas

1. When classifying examples and non-examples of living things, Subject A used three characteristics of living things during the pre-instruction interview and five characteristics during the post-instruction interview.
2. When classifying examples and non-examples of living things, Subject A used four characteristics of non-living things in the pre-instruction interview and six characteristics in the post-instruction interview.
3. Whereas many of the same characteristics of living and non-living objects were used to distinguish between examples and non-examples of living things during the pre-and post-instruction interviews, all responses or characteristics increased in frequency during the post-instruction interviews. The increase in the frequency with which characteristics were identified during the post-instruction interview, suggested that Subject A based her classification on a number of criteria rather than a single characteristic or limited information as often occurred during the pre-instruction interview.

4. During the pre-instruction interview, Subject A indicated only once that water was a requirement for living things and not necessary for non-living things. However, analysis of post-instruction data revealed a predominance of one idea - the need for water to sustain living things. The need for water was also used frequently to differentiate between objects which were living and those which were non-living.

5. At the end of the pre- and post-instruction interviews, Subject A provided definitions of living and non-living which were similar to the main ideas she expressed during the interviews. Subject A was able to express more ideas during the post-instruction when providing definitions for living and non-living.

6. During the pre-instruction interview, Subject A modified her original classifications of three pictures. When the pictures were first presented, Subject A classified the mushroom and the seed as non-living and the sun as non-living. As she provided her rationale for the classifications, Subject A changed her mind and classified all three pictures as examples of living things. Once the classifications were modified, she classified the post-instruction picture the same as the pre-instruction picture. Thus, all twenty pictures were eventually classified the same as either examples and non-examples of living things. The

the various classifications differed between the pre-and post-instruction interviews. The rationale provided during the post-instruction interview tended to be based on more information and Subject A was able to articulate her ideas more fully.

Indications of idea modification are as follows:

Example 1: During the pre-instruction interview, Subject A originally classified the mushroom as non-living on the basis that 'people cut it down'. However, Subject A also acknowledged that the mushroom was able to grow. With probing, Subject A revealed that the mushroom was alive in the summer and was not living during the winter months. Subject A was unable to distinguish between non-living and living things in a state of dormancy. Further, Subject A referred to non-living and once living objects as not-living.

During the post-instruction interview, Subject A classified the mushroom as a living thing on the basis of its ability to grow. Subject A was able to articulate the distinction between non-living and dead for she indicated that once cut, the mushroom was still living but that it would die.

Example 2: During the pre-instruction interview, Subject A initially classified the sun as non-living. However, as she articulated her idea she changed her classification of the sun to a living thing on the basis of its ability to shine and help things grow.

The classification of the sun as an example of a living thing remained unchanged during the post-instruction interview. Subject A indicated the sun was living because it provided warmth. She articulated that the sun did not possess nutritional needs nor was it capable of noise production. Nonetheless, she considered the sun to be living.

Example 3: during the pre-instruction interview, Subject A classified the seed as non-living. With probing, she indicated that seeds could grow and subsequently changed her classification of seeds to an example of a living thing. However, she was unable to articulate a reason for the classification.

During the post-instruction interview, Subject A classified the seed as a living thing on the basis of growth and nutritional needs. She did recognize and articulate that the seed was not capable of movement and noise production - two criteria she stated as characteristics of living things.

Summary

Subject A possessed a good background in relation to living and non-living which she must have acquired outside of her school experiences. Analysis of pre- and post-instruction data indicated that she strengthened and extended her original ideas and moved toward a more scientific understanding of living and non-living objects. Several ideas remained unchanged. For example, Subject A maintained throughout the study that unfertilized eggs were non-living. However, this represents a difficult notion to grasp.

Case Study B

Personal Characteristics and Background Information

Subject B, a male was five years four months at the time of the study. He was very eager to participate in the various individual and group activities. Subject B demonstrated some difficulty in expressing his ideas fully. Subject B did not participate in the entire instructional sequence due to illness. During the post-instruction interview there was evidence that Subject B was not fully recovered and this may have affected his ability to articulate ideas and concentrate

on the classification task. Prior to his participation in the study, he had received no formal instruction in science.

Pre- and Post-Instruction Clinical Interviews

During the pre-and post-instruction clinical interviews, the same living and non-living objects were displayed as for Subject A. Subject B classified the objects according to self-determined criteria and articulated the reason for the classification. During the pre-instruction clinical interview, Subject B classified ten of the seventeen objects into five distinct groups. Initially he grouped the seed and rock and indicated that both were hard. The various bean seeds were then placed together and Subject B indicated that they were hard and brown. The third group was comprised of the car and the dead frog which were both hard. Another group was formed using the fish bowl and the puppet. Again Subject indicated that these objects were hard. Lastly, Subject B placed the mealworms and the mosquitoes together, indicating that they were eating. The remaining seven objects were not classified.

During the post-instruction clinical interview, Subject B classified nine of the seventeen objects into two distinct groups. Initially he grouped the puppet and frog together and indicated that he could make them move. The second group consisted of the seeds, mosquitoes, celery, egg, leaves, plant

and fish which he identified as objects which could grow. He did not group the other eight objects.

Subject B demonstrated the ability to use classification systems during both the pre- and post-instruction interviews. Initially, the groups contained very few objects and he tended to focus on colour and texture. Although no reference was made to living and non-living objects during the post-instruction interview, he did classify objects according to several characteristics of living and non-living things.

General Patterns of Ideas Expressed During Pre- and Post-Instruction I.A.I. Interviews

Using the Interview-About-Instances technique, Subject B was presented 20 pictures each depicting an example or non-example of a living thing. He classified each picture and then provided a rationale for the classification. Table 4.3 highlights Subject B's ideas of living and non-living expressed during the pre- and post-instruction interviews.

Based on the frequency of response, the researcher compared the main ideas about living and non-living expressed by Subject B during the Interview-About-Instances, with the definitions provided by Subject B when asked by the researcher. They are:

Pre-Instruction Ideas and Definitions

Living: movement, lives in a house, dies, nutritional needs, growth.

Definition of living: living things move, eat and sleep.

Non-living: no self-movement, edible, no movement.

Definition of non-living: non-living things are things that died and are in heaven.

Post-Instruction Ideas and Definitions

Living: growth, movement, nutritional needs.

Definition of living: living things move, need drink and food and to sleep.

Once living: they were once living and then they died. They will never live again.

Non-living: no self-movement, no movement, and edible.

Definition of non-living: non-living things are dead and up in heaven. They don't need sleep and don't need to eat.

Table 4.3 Interview-About-Instances, Subject B

Living Characteristics	Interview	
	Pre-Instruction	Post-Instruction
	Frequency of response	Frequency of response
movement	6	6
dies	4	2
lives in house	4	
food	2	3
water	2	4
growth	2	6
bright	1	
warmth	1	
cleans self		1
sleep		1
chick inside	1	

Non-living Characteristics	Interview	
	Pre-Instruction	Post-Instruction
	Frequency of response	Frequency of response
no self-movement	3	4
no movement	2	3
edible	2	2
vegetable	1	
no talk/noise	1	
hard		1
no chick inside	1	
warmth		1

General Patterns in Expressed Ideas

1. When classifying examples and non-examples of living things, Subject B identified the same three characteristics during the pre and post-instruction interviews. Initially, he indicated that living things live in a house. However, this idea was not evident during the post-instruction interview.
2. When classifying examples and non-examples of living things, Subject B identified the same three characteristics of non-living things in the pre- and post-instruction interviews.
3. While many of the same characteristics of living and non-living objects were used to distinguish between examples and non-examples of living things during the pre- and post-instruction interviews, most of the characteristics increased in frequency during the post-instruction interview.
4. During the pre-instruction interview, Subject B identified growth only twice as a characteristic of living things. During the post-instruction interview, growth as a characteristic of living things was identified six times.
5. During the pre-instruction interview, Subject B did not use the term non-living but rather referred to objects as not

living. During the post-instruction interview, he utilized the term non-living but in global application. Although he was able to differentiate 'real' objects which were non-living from those which were once living, Subject B used the same word to refer to two different meanings. He was absent from the teaching session which focused on the differentiation between living, once living and non-living objects.

6. Subject B provided definitions of living and non-living following the pre- and post-instruction interviews. There was some similarity in the ideas about living things expressed during the pre-instruction interview and the definition provided by Subject B. The ideas expressed about non-living things during the pre-instruction interview were not articulated in the definition. Once again, Subject B demonstrated confusion between non-living objects and those which were once alive. Analysis of post-instruction data revealed a similar trend as indicated in the pre-instruction interview. There were similarities in the ideas expressed and the definition provided for living things. However, there were no similarities in the ideas expressed and the definition provided for non-living things.

7. During the interviews, Subject B classified four of the twenty pictures differently from pre- to post-instruction interviews.

Example 1: During the pre-instruction interview, Subject B classified the sun as living on the basis of its brightness. During the post-instruction interview, Subject B classified the sun as non-living based on the rationale that it 'heats things up', moves and doesn't require food.

Example 2: During the pre-instruction interview, Subject B classified the clouds as living indicating that they were capable of movement. Subject B, during the post-instruction interview, classified the clouds as non-living on the basis of their ability to drop rain.

Example 3: Subject B identified the seed as non-living during the pre-instruction interview, indicating that a seed must be planted and watered to grow. With prompting, Subject B indicated that he referred to the seed as not-living and was able to differentiate the seed from examples of non-living things. During the post-instruction interview, Subject B classified the seed as a living thing due to its ability to grow and its need for water.

Example 4: During the pre-instruction interview, Subject B classified the egg as an example of a non-living thing

because it was edible - "you don't eat living things!" When questioned about the egg containing a chick, Subject B referred to the egg as not-living for only the chick was living. During the post-instruction interview, Subject B indicated that the egg could be a living thing as well as a non-living thing. The egg was non-living when it was for eating. However, the egg could also be living if it contained a chick.

Summary

Subject B possessed some ideas about living things but appeared to have difficulty articulating his beliefs. When providing a rationale to support an idea, Subject B often gave a single idea to support his classification and could not be prompted further. Analysis of pre- and post-instruction data indicated that he modified several original ideas - the initial idea that living things live in a house was not used to differentiate living and non-living things in the post-instruction interview, and the recognition of growth as a characteristic of living things was evident in the post-instruction interview.

Case Study C

Personal Characteristics and Background Information

Subject C, a male, was five years seven months at the time of the study. Although he was interested in participating in the various activities, he fatigued easily, became distracted and had difficulty completing a number of the tasks. Although Subject C had difficulty expressing his ideas, he actively participated in group discussion. Prior to his participation in the study, Subject C had received no formal instruction in science.

Pre- and Post-Instruction Clinical Interviews

During the pre- and post-instruction clinical interviews, the same living and non-living objects were displayed as for Subject A. Subject C classified the objects according to self-determined criteria and articulated the reason for the classification.

During the pre-instruction clinical interview, Subject C classified eight of the seventeen objects into three groups. Initially he grouped the puppet and the squeeze toy together and indicated that they were toys. The next group consisted of the frog, fish, mosquitoes and mealworms, which were identified as animals. The third group was comprised of the

rock and seed, both of which were identified as hard. The nine remaining objects were not classified.

During the post-instruction clinical interview, Subject C classified eleven of the seventeen objects into three distinct groups. The first group consisted of the fish, frog and the mosquito larvae. Subject C placed these objects together because of their ability to swim underwater and their need to come up for food. The second group, which was comprised of the plant, egg, toy, puppet, and bingo chips, do not require food and cannot move. Lastly, Subject C placed the celery, seeds and leaves together and indicated that these objects did not require food.

Subject C demonstrated the ability to use classification systems during both the pre- and post-instruction interviews. Initially, the groups were formed on the basis of texture and identification. Although no reference was made to living and non-living objects during the post-instruction clinical interview, Subject C did classify objects according to several characteristics of living and non-living things.

General Patterns of Ideas Expressed During Pre- and Post-Instruction Interviews

Using the Interview-About-Instances technique, Subject C was presented twenty pictures each depicting an example or

non-example of a living thing. He classified each picture and then provided a rationale for the classification. Table 4.4 highlights Subject C's ideas of living and non-living expressed during the pre- and post-instruction interviews.

Based on the frequency of response, the researcher compared the main ideas about living and non-living expressed by Subject C during the Interview-About-Instances, with the definitions provided by Subject C when asked by the researcher.

Pre-Instruction Ideas and Definitions

Living: objects that inhabit a space, growth, nutritional needs, movement.

Definition of living: a motorcycle is living.

Non-living: objects that live outside, movement, no self movement.

Definition of non-living: they stay outside.

Table 4.4 Interview-About-Instances, Subject C

Living Characteristics	Interview	
	Pre-Instruction	Post-Instruction
	Frequency of response	Frequency of response
lives in a house	7	4
growth	4	1
plays with toys	2	
food	2	3
movement	2	5
water	2	5
magnets inside	1	
needs medicine	1	
bright		1
hot		1
easy to crack		1

Non-living Characteristics	Interview	
	Pre-Instruction	Post-Instruction
	Frequency of response	Frequency of response
lives outside	3	
movement	2	1
no self movement	1	2
rain comes out	1	1
water		1
hard		1
toy		1

Post-Instruction Ideas and Definitions

Living: movement, nutritional needs, lives in a house.

Definition of living: living things walk, move and make noise.

Once living: things that are dead.

Non-living: growth, no movement.

Definition of non-living: things that walk, move, and make noise.

General Patterns in Expressed Ideas

1. When classifying examples and non-examples of living things, Subject C used three characteristics of living things during the pre-instruction interview and two characteristics during the post-instruction interview.
2. When classifying examples and non-examples of living things, Subject C used one characteristic of non-living things in both the pre- and post-instruction interviews. The same characteristic -no self movement - was identified in both instances.

3. Subject C possessed different meanings for the terms living and non-living compared to the scientific view. The scientific view of 'living' refers to a state of being, whereas Subject C referred to living as a habitat or a place to 'live'.

4. During the pre-instruction interview, Subject C identified the following characteristics of living things: movement, nutritional needs, and growth. During the post-instruction interview, an increase in the frequency of response was noticed with respect to the characteristics of movement and nutritional needs. Growth was only identified once during the post-instruction interview.

5. During the pre-instruction interview, Subject C indicated on seven occasions that living things live in a house. Analysis of post-instruction data revealed that this idea no longer dominated his idea of living.

6. Following the pre- and post-instruction interviews, Subject C provided definitions of living and non-living which revealed little similarity with the ideas related to living and non-living during the pre- and post-instruction interviews.

7. Throughout the pre- and post-instruction interviews, Subject C referred to non-living things as not living. During the post-instruction interview, he used the terms not living and living interchangeably. Thus some of the characteristics of living things were also identified as characteristics of non-living things.

8. Subject C was unable to differentiate between objects which were living, once living, and non-living.

9. During the interviews, Subject C classified nine of the twenty pictures differently from pre- to post-instruction interviews.

Example 1: During the pre-instruction interview, Subject C originally classified the worm as non-living on the basis that it 'crawls around and goes under water'. During the post-instruction interview, he classified the worm as living and indicated once again that it lives under water. Subject C appeared unable to base his classification on the various characteristics of living things presented during the instructional sequence, but rather held to his original idea that 'living' referred to the place one inhabits.

Example 2: Subject C classified the flower as non-living during the pre-instruction interview based on the rationale that 'it stays out in the garden or somewhere in the grass'. With prompting, he indicated that the flowers have nutritional needs but he did not suggest that the flower was living. The researcher directed his attention to the plant on the table directly in front of him, and asked if that plant was living or non-living. Subject C replied that the plant was living because it was in the house.

During the post-instruction interview, Subject C classified the flower as living and indicated that flowers require water to grow. The classification and rationale provided by Subject C appeared to indicate a recognition of several characteristics of living things.

Example 3: During the pre-instruction interview, Subject C classified the mushroom as living on the basis that the mushroom had magnets inside. The researcher probed this idea further with Subject C to reveal the nature of the child's experiences with mushrooms. Subject C indicated that he had seen mushrooms growing in the ground. He again classified the mushroom as a living thing and indicated that mushrooms contained magnets.

During the post-instruction interview, Subject C classified the mushroom as non-living and indicated that mushrooms require water to grow. The researcher identified an inconsistency in ideas for Subject C used the same rationale to classify the flower as a living thing. Subject C was unable to articulate his idea further.

Example 4: Subject C classified the TV as living during the pre-instruction interview and indicated that the TV lived in the house. In spite of prompting, he was unable to articulate similarities between the boy, which he identified as living, and the TV. During the post-instruction interview, the TV was classified as non-living on the basis that it was incapable of movement.

Example 5: During the pre-instruction interview, Subject C classified the sun as an example of a non-living object, indicating that it was bright and outside. During the post-instruction interview, Subject C classified the sun as living but his rationale remained unchanged from the pre-instruction interview.

Example 6: Subject C classified the seed as a living thing during the pre-instruction interview, but was unable to articulate his reason for the classification.

During the post-instruction interview, he classified the seed as non-living on the basis that it 'grows outside in the garden'.

Summary

Subject C brought to the learning of living and non-living objects a belief that living things inhabit a space and non-living things reside out of doors. This belief differed significantly from the scientific view fostered throughout the instructional sequence. Although Subject C did not refer to living things as objects which inhabited a space as frequently during the post-instruction interview, no clear pattern of ideas emerged to replace this original idea. It appears that the counter evidence presented during the instructional sequence was so far removed from Subject C's conception of living things that he was unable to readily modify his existing ideas.

Case Study D

Personal Characteristics and Background Information

Subject D, a female, was five years eight months at the time of the study. She was a very outgoing child eager to

participate in the instructional sequence both through the completion of tasks and in group discussion. Subject D was an articulate child and had no difficulty expressing her ideas in relation to living and non-living objects. Prior to her participation in the study, she had received no formal science instruction.

Pre- and Post-Instruction Clinical Interviews

During the pre- and post-instruction clinical interviews, the same living and non-living objects were displayed as for Subject A. Subject D classified a number of the objects according to self-determined criteria and articulated the reason for the classification.

During the pre-instruction clinical interview, Subject D formed three distinct groups using very few objects. Initially she grouped the bean seeds together and indicated that they were brown and the same shape. The peas were placed together and Subject D indicated that they were bumpy, round, and dried up. The third group was comprised of the mealworm pupae which Subject D described as having 'bumpy backs and brown stripes on their backs'. Subject D did not classify the remaining objects.

During the post-instruction clinical interview, Subject D classified eight of the seventeen objects into four distinct groups. Initially she grouped the celery and leaves and indicated that both were dried up. The second group was

comprised of the bingo chips and squeeze toy which she identified as both having lots of colours. The third group included the frog and plant both of which were green. Lastly, she placed the mosquito larvae and the fish together, indicating that both could move around in water.

Subject D demonstrated the ability to use classification systems during both the pre- and post-instruction clinical interviews. During both interviews, she focused on few objects and classified according to common attributes such as colour, shape, texture and function. There was no reference made to living and non-living objects during the pre- or post-instruction clinical interviews.

General Patterns of Ideas Expressed During Pre- and Post-Instruction Interviews

Using the Interview-About-Instances technique, Subject D was presented twenty pictures each depicting an example or non-example of a living thing. She classified each picture and then provided a rationale for the classification. Table 4.5 highlights Subject D's ideas of living and non-living expressed during the pre- and post-instruction interviews.

Based on the frequency of response, the researcher compared the main ideas about living and non-living expressed by Subject D during the Interview-About-Instances, with the definitions provided by Subject D when asked by the researcher.

Pre-Instruction Ideas and Definitions

Living: movement, growth, death, and noise production.

Definition of living: living things move and need water.
People are living.

Non-living: no self movement, no noise production, no facial features.

Definition of non-living: things won't move or talk.

Post-Instruction Ideas and Definitions

Living: movement, nutritional needs, growth, noise production and death.

Definition of living: living things are alive. They can move, talk, and they need food and water. They have a face.

Once living: are living things then they died like the frog, the celery and the dried up leaves.

Table 4.5 Interview-About-Instances, Subject D

Living Characteristics	Interview	
	Pre-Instruction	Post-Instruction
	Frequency of response	Frequency of response
movement	6	7
growth	4	4
dies	3	2
talks/noise	2	3
water	1	7
shines	1	1
chick inside	1	1
lets rain out	1	1
food		3
respiration		1
lights up		1

Non-living Characteristics	Interview	
	Pre-Instruction	Post-Instruction
	Frequency of response	Frequency of response
no self movement	5	6
no noise/talk	3	3
no facial features	2	3
no respiration	1	
eating egg	1	1
toy	1	
garbage	1	
no water		1
no food		1
no growth		1
doesn't give rain		1

Non-living: no self movement, no facial features, no noise production.

Definition of non-living: things that can't grow and can't move.

General Patterns in Expressed Ideas

1. When classifying examples and non-examples of living things, Subject D used three characteristics of living things during the pre-instruction interview and four characteristics during the post-instruction interview.
2. When classifying examples and non-examples of living things, Subject D used two characteristics of non-living things in the pre-instruction interview and three characteristics in the post-instruction interview.
3. Subject D identified more characteristics of living and non-living objects during the post-instruction interview. There was also an increase in the frequency with which characteristics of living and non-living objects were identified during the post-instruction interview.
4. During the pre-instruction interview, Subject D indicated only once that water was a requirement for living things.

Analysis of post-instruction data revealed a predominance of one idea - the need for water to sustain living things.

5. During both the pre- and post-instruction interviews, Subject D expressed more ideas about living and non-living objects during the presentation of the pictures than she did when providing definitions of living and non-living.

6. Subject D was able to articulate an understanding of the distinction between non-living objects and those which were once living.

7. During the interviews, Subject D classified three of the twenty pictures differently from pre- to post-instruction interviews.

Example 1: During the pre-instruction interview, she originally classified the jet as living. She indicated that although the jet required someone to drive it, it would then go where it wants to go. Subject D appeared to indicate that the jet possessed a conscious. During the post-instruction interview, the jet was classified as non-living on the basis that it was not capable of self movement.

Example 2: During the pre-instruction interview, Subject D classified the seed as a non-living object and indicated that it was not capable of self movement. With probing, it was revealed that Subject D differentiated between seeds that are planted and seeds that are thrown in the garbage. Seeds from fruits, according to Subject D, were not capable of growth and were thrown in the garbage. During the post-instruction interview, Subject D classified the seed as living and indicated that seeds must be planted and given water to ensure growth.

Example 3: Subject D classified the water as non-living during the pre-instruction interview, on the basis that it did not possess facial features. During the post-instruction interview, she classified the water as an example of a living thing because it helped to sustain life.

Summary

Subject D possessed a range of ideas in relation to living and non-living. She applied her knowledge consistently throughout the interviews and the instructional sequence. Analysis of pre- and post-instruction data indicated that she modified several original ideas, the most significant change noted was her recognition that living things require an energy

supply (specifically water), although she stated incorrectly that water itself was a living thing.

Case Study E

Personal Characteristics and Background Information

Subject E, a female, was six years three months at the time of the study. She was very shy during the group activities and the instructional sequence, but always completed the tasks. Subject E spoke in a quiet voice and would not participate in discussion. She appeared more comfortable when with the researcher although much probing was necessary to encourage the expression of ideas. Subject E transferred to the school in September from a small rural school and studied the following science topics during her Kindergarten year: hibernation, winter birds, plants and farm animals.

Pre- and Post-Instruction Clinical Interviews

During the pre- and post-instruction clinical interview, the same living and non-living objects were displayed as for Subject A. Subject E classified the objects according to self-determined criteria and articulated the reason for the classification.

During the pre-instruction clinical interview, Subject E would not spontaneously categorize the objects displayed. Since Subject E had indicated an interest in the pop-up puppet, the researcher suggested that she group objects together that were the same as the puppet. After lengthy deliberation, Subject E grouped the puppet and the squeeze toy together and indicated that they both had sticks on them. She would not classify any of the remaining objects.

During the post-instruction clinical interview, Subject E classified four of the seventeen objects into two distinct groups. The first group consisted of the fish and mosquito larvae which she identified as living things. The second group was comprised of the celery and leaves which she indicated were both dried up and not living. Subject E did not classify the remaining objects.

Subject E demonstrated an increased ability to use classification systems during the post-instruction interview. She spontaneously classified objects on the basis of living and non-living. Although she used the term not living, she clearly demonstrated an understanding of the classification system and the language used to describe the classifications.

General Patterns of Ideas Expressed During Pre- and Post-
Instruction Interviews

Using the Interview-About-Instances technique, Subject E was presented twenty pictures each depicting an example or non-example of a living thing. She classified each picture and then provided a rationale for the classification. Table 4.6 highlights Subject E's ideas of living and non-living expressed during the pre- and post-instruction interviews.

Based on the frequency of response, the researcher compared the main ideas about living and non-living expressed by Subject E during the Interview-About-Instances, with the definitions provided by Subject E when asked by the researcher. They are:

Pre-Instruction Ideas and Definitions

Living: movement, standing, nutritional needs.

Definition of living: living things move. They need food and water.

Non-living: No nutritional needs, no self movement.

Definition of non-living: they can't move by themselves.

And they don't need food and drink.

Table 4.6 Interview-About-Instances, Subject E

Living Characteristics	Interview	
	Pre-Instruction	Post-Instruction
	Frequency of response	Frequency of response
movement	6	2
standing	2	2
food	2	5
water	2	7
noise/talk	1	
blossoming	1	
die	1	
shines	1	1
chick in it	1	1
pours rain	1	
sleeps		2
growth		4
respiration		1
edible		1
warmth		1

Non-living Characteristics	Interview	
	Pre-Instruction	Post-Instruction
	Frequency of response	Frequency of response
no food	4	8
no self movement	4	4
no chick in it	1	1
no facial features		1
no water		7
does not shine		1
noise production		1

Post-Instruction Ideas and Definitions

Living: nutritional needs, growth, movement, require sleep.

Definition of living: living things need food and water. They can move. They breath.

Once living: living things that died.

Non-living: no nutritional needs, no self movement.

Definition of non-living: They don't need food and water. They don't move.

General Patterns in Expressed Ideas

1. During the pre-instruction interview, Subject E confused the pictures presented with the objects they represent. Therefore, it was necessary to focus her attention on real objects to avoid all pictures being classified as non-living. This confusion was not evident during the post-instruction interview.

2. When classifying examples and non-examples of living things, Subject E used four characteristics of living things during the pre-instruction interview and five characteristics during the post-instruction interview.

3. When classifying examples and non-examples of living things, Subject E used two characteristics of non-living things in the pre-instruction interview and three characteristics in the post-instruction interview.

4. Many of the same characteristics of living and non-living objects were used to distinguish between examples and non-examples of living things during the pre- and post-instruction interviews, all characteristics increased in frequency except for movement during the post-instruction interview. Subject E indicated that non-living things were also capable of movement.

5. During the pre-instruction interview, Subject E indicated four times that living things had nutritional needs. However, analysis of post-instruction data revealed a predominance of one idea - the need for food and water to sustain life. There was also a significant increase in the frequency with which she indicated that non-living things had no nutritional needs during the post-instruction interview.

6. Following the pre- and post-instruction interviews, Subject E provided definitions of living and non-living which were very similar to the main ideas she expressed during both the pre- and post-instruction interviews.

7. Subject E was able to articulate an understanding of the distinction between non-living objects and those which were once living. Moreover, she could distinguish between dead and the state of dormancy.

8. During the interviews, Subject E classified four of the twenty pictures differently from pre- to post-instruction interviews.

Example 1: During the pre-instruction interview, Subject E originally classified the rock as living although she was unable to provide a rationale for the classification. During the post-instruction interview, Subject E classified the rock as non-living and indicated that it did not possess nutritional needs and it was not capable of movement.

Example 2: Subject E identified the clouds as an example of a living thing during the pre-instruction interview, indicating that clouds pour rain. During the post-instruction interview, Subject E classified the clouds as non-living on the basis that they don't require an energy supply, don't move and 'don't shine like the sun'.

Example 3: During the pre-instruction interview, Subject E classified the fire as living and indicated that it could spread. During the post-instruction interview, Subject E indicated that the fire was both living and non-living for it could 'warm like the sun' but it did not possess nutritional requirements.

Example 4: Subject E identified the seed as non-living during the pre-instruction interview, indicating that it did not possess nutritional requirements and was not capable of movement. However, during the post-instruction interview, Subject E classified the seed as an example of a living thing due to its ability to grow and its need for water.

Summary

Subject E was able to express her ideas in relation to living and non-living more fully during the post-instruction interview. Analysis of the pre- and post-instruction interview data, indicate that she strengthened and extended her original ideas and moved toward a more scientific understanding of living and non-living objects. Subject E demonstrated consistency in her ideas particularly throughout the post-instruction interview.

Case Study F

Personal Characteristics and Background Information

Subject F, a male, was six years four months at the time of the study. He was very eager to participate in the activities and the discussions. Although Subject F was a verbal child, probing was required to reveal his ideas about living and non-living objects. Prior to his participation in the study, he had received formal science instruction during his Kindergarten year in the following areas: Properties of Objects; Earth, Space and Time; Changes in Matter and Energy. Formal science instruction in Grade One focused on 'Changes in Seasons' and 'Preparation For Winter'.

Pre- and Post-Instruction Clinical Interviews

During the pre- and post-instruction clinical interview, the same living and non-living objects were displayed as for Subject A. Subject F classified the objects according to self-determined criteria and articulated the reason for the classification.

During the pre-instruction clinical interview, Subject F classified eleven of the seventeen objects into five distinct groups. The first group was comprised of the plant and frog, both of which were green. Secondly, he grouped the mosquitoes and mealworms and indicated that they were both bugs. The third group was comprised of the squeeze toy, car

and puppet. Subject F indicated that 'they are sort of like toys'. He then grouped the peach seed and other seeds, indicating that they were all seeds. Lastly, he grouped the fish and rock together and indicated that both 'are in the sea'. The remaining six objects were not classified.

During the post-instruction clinical interview, Subject F classified eleven of the seventeen objects displayed into three groups. The first group was comprised of the puppet, bingo chips, and the squeeze toy which Subject F identified as non-living objects. He then grouped the celery, frog and leaves together and indicated that these objects were once living. Finally he placed the plant, fish, mosquitoes, seeds and egg together and identified the objects as living.

Subject F demonstrated the ability to use classification systems during both the pre- and post-instruction interviews. Initially, he classified on the basis of colour, class inclusion and object location. However, during post-instruction classification, Subject F classified objects on the basis of living and non-living and clearly demonstrated an understanding of the classification system and the language used.

General Patterns of Ideas Expressed During Pre- and Post- Instruction Interviews

Using the Interview-About-Instances technique, Subject F was presented twenty pictures each depicting an example or non-example of a living thing. He classified each picture and then provided a rationale for the classification. Table 4.7 highlights Subject F's ideas of living and non-living expressed during the pre- and post-instruction interviews.

Based on the frequency of response, the researcher compared the main ideas about living and non-living expressed by Subject F during the Interview-About-Instances to the definitions provided by Subject F when asked by the researcher.

Pre-Instruction Ideas and Definitions

Living: movement, facial and human features, growth, noise production and nutritional needs.

Definition of living: living things have a heart, move, grow, have legs, skin, body, hands, claws, stomach and facial features. You don't cut living things. They breath, talk and they die.

Table 4.7 Interview-About-Instances, Subject F

Living Characteristics	Interview	
	Pre-Instruction	Post-Instruction
	Frequency of response	Frequency of response
movement	7	4
body parts	5	7
facial features	4	8
growth	3	4
water	2	4
noise/talk	2	4
sun	2	2
dies	1	1
breathes	1	1
warmth	1	2
clothes	1	1
pours rain	1	
chick in it	1	1
food		7

Non-living Characteristics	Interview	
	Pre-Instruction	Post-Instruction
	Frequency of response	Frequency of response
no facial features	6	5
no body parts	5	6
no self movement	4	4
edible	2	1
no clothes	2	3
toy	2	1
chick in it	1	1
noise		2
no food		2
no water		2
no heart		1

Non-living: no facial features, no human or animal features, no self movement, edible, no clothes and toys are non-living.

Definition of non-living: a reptile is non-living because it doesn't have a heart, no legs, no feet and no face.

Post-Instruction Ideas and Definitions

Living: nutritional needs, facial features, movement, noise production, growth and has skin.

Definition of living: living things move. talk, make noises and eat and drink.

Once living: they were living but now they are dead.

Non-living: no feet, no facial features, no self movement and doesn't require clothes.

Definition of non-living: don't move, don't talk, don't eat, don't drink, don't grow and don't have a heart.

General Patterns in Expressed Ideas

1. When classifying examples and non-examples of living things, Subject F used three characteristics of living things during the pre-instruction interview and the same three characteristics during the post-instruction interview.
2. When classifying examples and non-examples of living things, Subject F used one characteristic of non-living things in the pre-instruction interview and the same characteristic during the post-instruction interview.
3. Subject F used many of the same characteristics of living and non-living objects to distinguish between examples and non-examples of living things during the pre- and post-instruction interviews. Subject F applied his knowledge related to living and non-living objects in a very consistent manner.
4. During the pre- and post-instruction interviews, Subject F clearly demonstrated through the frequency of responses, his identification of facial and other human/animal features as a criterion for distinguishing between living and non-living.
5. During the pre-instruction interview, Subject F did not indicate that food was a requirement for living things and not

necessary for non-living things. Analysis of post-instruction data revealed a predominance of the need for food to sustain living things. The need for food was also used on two occasions to differentiate between objects which were living and those which were non-living.

6. When differentiating between living and non-living things during the pre-instruction interview, Subject F identified ten criteria which he considered characteristics of non-living things. According to the scientific definition of living/non-living, Subject F identified one characteristic of non-living things. During the post-instruction interview, Subject F identified three scientific characteristics of non-living objects.

7. At the completion of the pre- and post-instruction interviews, Subject F provided definitions of living and non-living which were similar to the main ideas expressed during the interviews. When providing definitions, Subject F focused more on the 'scientific' attributes of living and non-living things and less on the presence or absence of human features.

8. During the post-instruction interview, Subject F was able to articulate an understanding of the distinction between non-living objects and those which were once living.

9. During the interviews, Subject F classified three of the twenty pictures differently from pre- and post-instruction interviews.

Example 1: During the pre-instruction interview, Subject F classified the sun as living on the basis that it 'shines, moves, makes things warm and goes around the earth'. He also indicated that the sun did not have skin. During the post-instruction interview, Subject F classified the sun as an example of a non-living object and indicated that the sun did not possess nutritional needs.

Example 2: Subject F originally classified the clouds as living during the pre-instruction interview because they move and send down rain. During the post-instruction interview, he indicated that the clouds were non-living since they did not possess human features.

Example 3: During the pre-instruction interview, Subject F classified the seed as non-living. Although he indicated that the seed could grow, Subject F concluded that the seed did not possess facial features and therefore was non-living. During the post-instruction interview, Subject F classified that seed as an example of a living thing. He was able to articulate that seeds

make other plants, they grow, and require an energy supply.

Summary

Subject F possessed ideas related to living and non-living objects and applied this knowledge consistently throughout the pre- and post-instruction interviews. During both interviews, Subject F relied heavily on the presence or absence of human features (face, skin, legs) when distinguishing between example and non-examples of living things. Whereas several ideas remained unchanged, he frequently indicated during the post-instruction interview, that living things require an energy supply.

Case Study G

Personal Characteristics and Background Information

Subject G, a female, was six years four months at the time of the study. She was an outgoing child and very eager to participate in activities and discussion. Subject G was an articulate child and had no difficulty expressing ideas related to living and non-living objects. Prior to her participation in the study, she had received formal science instruction during her Kindergarten year in the following

areas: Properties of Objects; Earth, Space and Time: Changes in Matter and Energy. Formal science instruction in Grade One focused on 'Changes in Seasons' and 'Preparation For Winter'.

Pre- and Post-Instruction Clinical Interviews

During the pre- and post- instruction clinical interview, the same living and non-living objects were displayed as for Subject A. Subject G classified the objects according to self-determined criteria and articulated the reason for the classification.

During the pre-instruction clinical interview, Subject G classified five of the seventeen objects into three groups. Initially she grouped several bean seeds and indicated that they were brown, small and all beans. The puppet, squeeze toy and car were then placed together and Subject G indicated that they were all toys. Finally, the various peas were grouped together on the basis of their colour. The remaining objects were not classified.

During the post-instruction clinical interview, Subject G classified seven of the seventeen objects into three distinct groups. The first group was comprised of the squeeze toy and the puppet. Subject G identified the two objects as toys. The second group, comprised of the mosquitoes, fish and frog, were placed together because 'they all live in water'.

Finally, Subject G grouped the celery and the egg together which she identified as food.

Subject G demonstrated the ability to use classification systems during both the pre- and post-instruction clinical interviews. On both occasions the groups contained few objects and Subject G made no reference to living or non-living objects.

General Patterns of Ideas Expressed During Pre- and Post-Instruction Interviews

Using the Interview-About-Instances technique, Subject G was presented twenty pictures each depicting an example or non-example of a living thing. She classified each picture and then provided a rationale for the classification. Table 4.8 highlights Subject G's ideas of living and non-living expressed during the pre- and post-instruction interviews.

Based on the frequency of response, the researcher compared the main ideas about living and non-living expressed by Subject G during the Interview-About-Instances with the definitions provided by Subject G when asked by the researcher.

Pre-Instruction Ideas and Definitions

Living: movement, respiration, growth and nutritional needs.

Table 4.8 Interview-About-Instances, Subject G

Living Characteristics	Interview	
	Pre-Instruction	Post-Instruction
	Frequency of response	Frequency of response
movement	5	5
respiration	3	2
growth	3	4
water	3	9
food	2	6
chick inside	1	1
heart		5
noise/talk		2
die		1
facial features		1
light		1
warmth		1

Non-living Characteristics	Interview	
	Pre-Instruction	Post-Instruction
	Frequency of response	Frequency of response
no self movement	6	6
no respiration	6	9
no facial features	6	2
no heart	2	9
no chick inside	1	1
toy	1	
no facial features		2
not alive		2
no growth		1
no water		1
no food		1

Definition of living: Living things are alive. They can walk, move, breath and they have a heart.

Non-living: no self movement, no respiration, absence of facial features and no heart.

Definition of non-living: They can't breath, can't move and don't have a heart.

Post-Instruction Ideas and Definitions

Living: nutritional needs, movement, has a heart, growth, noise production and respiration.

Definition of living: living things move, grow, need water and food and have a heart.

Once living: They are living things that died. They were once living and once growing. They growed and then they stopped growing.

Non-living: no respiration, no heart, no self movement, not alive, and no facial features.

Definition of non-living: They can't move by themselves. They don't have a heart. They can't grow. They don't need food. And they were never living.

General Patterns in Expressed Ideas

1. When classifying examples and non-examples of living things, Subject G used five characteristics of living things during the pre-instruction interview and six characteristics during the post-instruction interview.

2. When classifying examples and non-examples of living things, Subject G used two characteristics of non-living things and five characteristics in the post-instruction interview.

3. Whereas many of the same 'scientific' characteristics of living and non-living objects were used to distinguish between examples and non-examples of living things during the pre- and post-instruction interviews, all characteristics, with the exception of one, increased in frequency during the post-instruction interview. During the post-instruction interview, Subject G also referred to many other features which she identified as characteristics of living things.

4. During the pre-instruction interview, Subject G indicated on five occasions that living things have nutritional needs. Analysis of post-instruction interview data indicated that nutritional needs as a characteristic of living things was identified fifteen times.

5. Subject G indicated in the post-instruction interview that living things have a heart. This characteristic was identified on five occasions. When asked about the presence of a heart in plants, Subject G was unable to respond.

6. During the post-instruction interview, Subject G articulated a clear understanding of the relation between living and non-living objects. She was able to indicate that non-living things did not have the same requirements as living things.

7. Following the pre- and post-instruction interviews, Subject G provided definitions of living and non-living which were very similar to the main ideas she expressed during the interviews.

8. Subject G, during the post-instruction interview, was able to articulate an understanding of the distinction between non-living objects and those which were once living.

9. During the interviews, Subject G classified one of the twenty pictures differently from pre- to post-instruction interviews.

Example 1: During the pre-instruction interview, Subject G classified the seed as non-living on the basis of no observable movement and respiration. 'It's not

moving unless somebody picks it up. It doesn't have a face and it can't breathe'. However, during the post-instruction interview, Subject G indicated that the seed was living due to its ability to grow and its need for water, light and warmth.

Summary

Subject G possessed a good background knowledge of living and non-living objects which she acquired through her formal science instruction in Kindergarten and probably from her out of school experiences. Subject G applied her knowledge of living and non-living in a very consistent manner throughout the interviews. Although her classification of pictures varied only slightly from the pre- to post-instruction interview, the rationale she provided for the classifications focused on 'scientific' characteristics of living things during the post-instruction interview. Subject G extended and consolidated her original ideas in relation to living and non-living objects.

Case Study H

Personal Characteristics and Background Information

Subject H, a male, was six years six months at the time of the study. He was eager to participate in the various

individual and group activities. Subject H possessed many ideas in relation to living and non-living objects which he articulated with ease. Prior to his participation in the study, Subject H had received formal science instruction during his Kindergarten year in the following areas: Properties of Objects; Changes in Matter and Energy; Earth, Space and Time. Formal science instruction in Grade One focused on 'Changes in Seasons' and 'Preparation For Winter'.

Pre- and Post-Instruction Clinical Interviews

During the pre- and post-instruction clinical interview, the same living and non-living objects were displayed as for Subject A. Subject H classified the objects according to self-determined criteria and articulated the reason for the classification.

During the pre-instruction clinical interview, Subject H classified nine of the seventeen objects into five distinct groups. Initially he grouped the bean seeds and indicated that they were beans, had white spots and were small. The second group was comprised of peas. Subject H indicated that they were green, squishy, round and small. Subject H then placed the fish and mosquito together and indicated that both were living, both live in the water, move a lot and that they 'sort of have wings'. The fourth group was comprised of the puppet, car and squeeze toy which Subject H identified as toys incapable of movement. The last group, which consisted of the

frog and bulb, were placed together 'because they were once living'. The remaining eight objects were not classified.

During the post-instruction clinical interview, Subject H classified eleven of the seventeen objects into three distinct groups. Initially he grouped the fish, seeds, mosquitoes and plant and indicated that they were living. The second group was comprised of the bingo chips, puppet, and toy which he indicated were never living. Lastly, Subject H placed the egg, celery, leaves and frog together, indicating that they were dead and at one time living.

Subject H demonstrated the ability to use classification systems during both the pre- and post-instruction interviews. Subject H was able to identify objects that were once living during both the pre- and post-instruction interviews. Subject H classified objects in relation to living and non-living during the post-instruction interview. He clearly demonstrated an understanding of the classification system and the language used.

General Patterns of Ideas Expressed During Pre- and Post-Instruction Interviews

Using the Interview-About-Instances technique, Subject H was presented twenty pictures each depicting an example or non-example of a living thing. He classified each picture and then provided a rationale for the classification. Table 4.9 highlights Subject H's ideas of living and non-living expressed during the pre- and post-instruction interviews.

Table 4.9 Interview-About-Instances, Subject H

Living Characteristics	Interview	
	Pre-Instruction	Post-Instruction
	Frequency of response	Frequency of response
movement	7	4
food	6	2
noise/talk	3	2
human qualities	3	
water	2	2
in the ground	2	
respiration	1	1
facial features	1	1
needs sun	1	1
chick inside	1	1
growth		3
die		2
heart		1
edible		1

Non-living Characteristics	Interview	
	Pre-Instruction	Post-Instruction
	Frequency of response	Frequency of response
no facial features	7	1
no human qualities	5	
no self movement	5	5
no noise/talk	4	1
not in ground	2	1
no human features	2	1
toy	1	
no chick inside	1	1
no water		5
no food		3
no heart		1

Based on the frequency of response, the researcher compared the main ideas about living and non-living expressed by Subject H during the Interview-About-Instances with the definitions provided by Subject H when asked by the researcher.

Pre-Instruction Ideas and Definitions

Living: movement, nutritional needs, noise production, and human qualities.

Definition of living: Living things move, talk, hear, and walk. They have ears and need food and drink.

Non-living: absence of facial features, no human qualities, no self movement, and no noise production.

Definition of non-living: They don't move. Don't have eyes. Don't have a mouth. You can't hear it. It can't smell and it can't talk.

Post-Instruction Ideas and Definitions

Living: movement, growth, nutritional needs, death, noise production and need sun.

Definition of living: They can move by themselves.
Living things eat, talk, walk, die and grow.

Once living: Things that used to be living but
are now dead.

Non-living: no self movement, and no nutritional needs.

Definition of non-living: They don't eat. They can't
walk. They don't drink. They were never living.

General Patterns in Expressed Ideas

1. When classifying examples and non-examples of living things, Subject H used four characteristics of living things during the pre-instruction interview and six characteristics during the post-instruction interview.
2. When classifying examples and non-examples of living things, Subject H used one 'scientific' characteristic of non-living things in the pre-instruction interview and three characteristics during the post-instruction interview.
3. During the pre-instruction interview, Subject H identified the presence or absence of 'human qualities' as a main criteria for distinguishing between living and non-living objects. When making reference to human qualities, Subject

H referred to the object's ability to hear and smell. No reference to human qualities was made during the post-instruction interview.

4. Whereas a number of the same characteristics of living and non-living objects were used to distinguish between examples and non-examples of living things during the pre- and post-instruction interviews, most of these characteristics decreased in frequency during the post-instruction interview. The decrease in the frequency with which the characteristics were identified, suggested that Subject H focused on several characteristics of living things during the post-instruction interview which he had not identified during the pre-instruction interview.

5. During the pre-instruction interview, Subject H suggested absence of facial features as a criterion for identifying non-living objects on seven occasions. Analysis of post-instruction data indicated that this idea began to lose status, for Subject H referred to the absence of facial features only once.

6. During the pre-instruction interview, Subject H did not acknowledge that non-living objects do not require an energy supply. However, during the post-instruction interview, Subject H made reference to this idea on eight occasions.

7. At the completion of the pre- and post-instruction interviews, Subject H provided definitions of living and non-living which were very similar to the main ideas he expressed during the interviews. Subject H was able to focus on several 'scientific' characteristics of living things during the post-instruction interview.
8. During the pre- and post-instruction interviews, Subject H was able to articulate an understanding of the distinction between non-living objects and those which were once living.
9. During the pre-instruction interview, Subject H indicated the importance of plants and trees 'being in the ground'. When asked to explain what would happen to a flower when it was picked or removed from the ground, Subject H indicated that the plant would become non-living. During the post-instruction interview, when asked the same question, Subject H indicated that the flower would die unless it was placed in water.
10. During the interviews, Subject H classified two of the twenty pictures differently from pre- to post-instruction interviews.

Example 1: During the pre-instruction interview, Subject H classified the sun as an example of a living thing on the basis of movement. 'I don't know what it eats. It doesn't have eyes or a mouth and it can't hear, but I think it's a living thing'. During the post-instruction interview, Subject H classified the sun as non-living and indicated that it did not require warmth and water.

Example 2: Subject H classified the egg as living during the pre-instruction interview. However, through probing, it became apparent that he did not consider the egg to be living in all situations. "The egg is living because chickens live in it when they're a baby. But when the chick comes out it's not living any more". Interestingly, Subject H classified the egg as once living (dead) during the post-instruction interview. "It was once living. The egg isn't living any more because it doesn't have a chicken inside any more. But this egg might be living because you never know if it has a chicken inside or not".

Summary

Subject H possessed a good background in relation to living and non-living which he acquired through formal science instruction in Kindergarten and from his out of school

experiences. Subject H applied his knowledge consistently during both the pre- and post-instruction interviews. Analysis of pre- and post-instruction data indicated that he strengthened and extended his original ideas and moved toward a more scientific understanding of living and non-living objects. During the post-instruction interview, Subject H did not identify facial features and human qualities as frequently and focused on more 'scientific' characteristics of living things.

General Ideas Expressed in Relation to Living and Non-living

Using the I.A.I. method, the researcher was able to ascertain five and six year old children's ideas of living and non-living objects. During both the pre- and post-instruction interviews, children were asked to classify pictures as examples or non-examples of living things and provide reasons for the classifications. The characteristics of living and non-living objects as identified by the eight children are represented in Tables 4.10 and 4.11.

1. During the pre-instruction interview, all subjects used the terms 'living' and 'not living' although the researcher

referred to the terms as 'living' and 'non-living'. Analysis of post-instruction data indicated that seven of the eight children were able to distinguish between objects which were once-living and objects which were non-living. These children were able to utilize the term 'non-living' during the post-instruction interviews.

2. During the pre-instruction interview, all children identified movement and nutritional needs as the main characteristics of living things as indicated in Table 4.10. On average, each child used movement as a criterion for the classification of living things four times, and nutritional needs three times. During the post-instruction interview, all children identified nutritional needs, movement and growth as the main characteristics of living things. However, nutritional needs was referred to with increased frequency. On average, each child used nutritional needs as a characteristic of living things ten times, movement five times, and growth four times.

Table 4.10 Characteristics of Living Objects Expressed During I.A.I.

Living	Interview	
	Pre-Instruction	Post-Instruction
Scientific ideas	No. of children responding	No. of children responding
movement	8	8
nutritional needs	8	8
growth	6	8
animate/inanimate	5	
noise production	4	4
death	4	6
respiration	3	5
human features	2	3
have heart	2	2
Other Expressed Ideas		
sun moves/shines	6	4
egg has chick in it	6	4
seeds grow	4	
clouds pour rain	4	1
live in a house	2	1
not edible	2	
human qualities	1	
require warmth		5
require sleep		2
wear clothes		1
edible		1

3. Most children made reference to growth in relation to the plants whereas very few children mentioned growth as a characteristic of human beings and other animals. This finding appeared to indicate that growth is a slow and gradual process in relation to human beings and other animals, and young children tended to focus on the more dynamic characteristics of living things - movement and nutritional needs. In relation to plants, however, growth was identified by six children as a characteristic of living things.

4. An interesting finding which emerged during both the pre- and post-instruction interviews was the importance of the presence and/or absence of facial and body features as a rationale for distinguishing between living and non-living objects. Children tended to use this criterion frequently when identifying non-living objects as indicated in Table 4.11.

5. Respiration was identified as a characteristic of living things by three of the six year old children during the pre-instruction interview. All three referred to respiration when identifying the fish as a living thing. Two of the three

Table 4.11 Characteristics of Non-living Objects Expressed During I.A.I.

Non-living Scientific ideas	Interview	
	Pre-Instruction	Post-Instruction
	No. of children responding	No. of children responding
no self-movement	8	8
no human features	4	5
no noise/talk	3	3
edible	3	
no food/water	2	6
no growth	1	3
no heart	1	3
Other Expressed Ideas:		
no chick in it	8	4
seeds - thrown out	3	
cut - not living	3	
no respiration	2	
live outside	1	
no human qualities	1	
no warmth		1
no sleep		1
edible		1
not in ground		1

children also made reference to respiration when discussing the picture of the boy. No five year old children made reference to respiration. During the post-instruction interview, respiration was identified as a characteristic of living things by five children, four six year old children and one five year old child.

7. During the pre-instruction interview, four of the eight children changed their original classification of a picture as they reasoned aloud. Interestingly, two children, one five year old and one six year old, correctly classified the pictures of living things. When the picture presented represented an example of a non-living object, two children, one five year old and one six year old, classified the pictures incorrectly. This change in classification was observed with one child during the post-instruction interview where she incorrectly classified a non-living object.

8. Most children identified more 'scientific' characteristics of living objects than of non-living objects during both the pre- and post-instruction interviews. Five of the eight children identified more 'scientific' characteristics of living things during the post-instruction interview. The remaining three children identified the same number of 'scientific' characteristics of living things during the pre- and post-instruction interviews. Although the number of

characteristics remained the same, the specific characteristics identified often varied from pre- to post-instruction interviews.

9. Six of the eight children classified the sun as an example of a living thing during the pre-instruction interview. The ideas expressed were as follows:

- "I don't know what it eats but it moves. It doesn't have eyes or a mouth and it can't hear but I think it's a living thing."

- "It shines and it moves. It makes things warm. It doesn't have skin. It goes around the earth."

- "If the sun wasn't alive it wouldn't shine as much."

- "It shines on people when it's hot outside. It moves sometimes. It doesn't need to eat."

- "It shines on people and makes the flowers grow. It grows too because it can make it more brighter."

- "It's bright."

Most children appeared unable to separate the sun as a non-living object from something that sustains life. The children also focused on movement and growth. During the post-

instruction interview, four of the eight children classified the sun as non-living.

10. Seven of the eight children were able to distinguish between and articulate different types of movement. While these children readily identified movement as a characteristic of living things, they also recognized that non-living objects were also capable of movement. The children indicated that non-living objects could not move by themselves and they were often restricted to a limited range of movement.

11. No children spontaneously classified objects during the pre-instruction clinical interview on the basis of living and non-living. One child however, did form one group of objects which was comprised of objects which were once living. During the post-instruction clinical interview, four of the eight children classified objects on the basis of living and non-living. Although no reference was made to living or non-living, two children classified objects according to characteristics of living things. During the post-instruction interview, six of the eight children were able to articulate an understanding of the distinction between non-living objects and those which were once living.

Comparison of Ideas on Living and Non-living Between Five and Six Year old Children

Analysis of pre- and post-instruction data revealed differences in conceptions related to living and non-living objects between five and six year old children. Firstly, when asked to classify various living and non-living objects during the post-instruction clinical interview, three six year old children spontaneously classified on the basis of living and non-living compared to only one five year old.

During the post-instruction I.A.I. interview, all the six year old children identified more attributes of living things which they identified as characteristics of living things as compared to the five year old children. On average, the six year olds identified thirteen attributes of living things whereas the five year old children identified nine attributes.

During the pre-instruction interview, three of the four six year old children identified respiration as a characteristic of living things. No five year old children made reference to respiration. During the post-instruction interview, respiration was identified by all the six year old children and one five year old. Six year old children also focused on the presence of a heart and facial features to distinguish between living and non-living objects. One five year old child made reference to facial features.

The six year old children were more articulate than the five year olds and could express their ideas with increased ease. They tended also to provide a more complete rationale when classifying pictures of living and non-living objects during the Interview-About-Instances when compared to the five year old children.

The five year old children appeared to have more difficulty than the six year olds when classifying the 'natural' non-living objects. The five year old children tended to retain their original ideas and classify several of the pictures as living things during the pre- and post-instruction interviews. The six year olds tended to classify the sun and clouds as living things, but this classification occurred only during the pre-instruction interview.

Differences between the five and six year children were apparent in the number of correct classifications made during the Interview-About-Instances. On average, the six year old children made three incorrect classifications during the pre-instruction interview compared to six incorrect classifications made by the five year olds. During the post-instruction interview, the six year olds made one incorrect classification compared to three incorrect classifications made by the five year old children.

Although all children's ideas changed positively from the pre- to post-instruction interviews, there were differences in the ideas expressed and the reaction to instruction between

the five and six year old children. During the instructional sequence, the six year olds tended to express ideas more openly and question the points of view expressed by others during informal discussion when compared with the five year olds. Further, the six year old children had no difficulty completing the various tasks which comprised the instructional sequence. The five year olds tended to have a little difficulty remaining on task and working through to completion. These behaviours may indicate that the nature of the content was less appropriate for the five year old children. Whereas all of the children brought to the learning of this topic ideas which reflected their personal experiences, the five and six year old children differed in their conceptions of living and non-living objects.

Description of the Effectiveness of the Instructional Sequence

The instructional sequence was based essentially on the conceptual conflict strategy. This teaching strategy utilizes the presentation of counter-evidence to children's current ideas in an attempt to promote an acceptance of the scientific viewpoint. The five and six year old children's ideas about living and non-living objects expressed during the pre-instruction interviews, formed the basis of the development of the instructional sequence. The teaching sequence was

designed to build upon the children's expressed ideas and progress through developmentally appropriate activities designed to promote conceptual change.

Four activities were selected, one to focus on each characteristic of living organisms as stated in the Manitoba Science Curriculum, Grade One. All activities selected attempted to present the 'scientist's view' of living things, thus helping children construct a scientific framework. The four activities selected which comprised the instructional sequence were designed to help children focus on the criterial attributes of living things and help children understand the need to examine the range of attributes which differentiate living and non-living objects. Each of the activities selected (see pp. 3.22 - 3.25 for description of activities) attempted to promote conceptual conflict through the presentation of a discrepant event or contradictory evidence to the children's existing ideas.

Analysis of the Case Studies indicated that all eight of the children modified their original ideas in relation to living and non-living following participation in the instructional sequence. Seven of the eight children strengthened and extended their original ideas following instruction and moved toward a more 'scientific' understanding of living things. One child, Subject C, believed that living referred to a habitat rather than a state of being, modified his original idea but was unable to replace it with another

viewpoint. He was, however, able to identify several 'scientific' characteristics of living things which aided in the classification of the pictures.

All children classified more pictures of living and non-living objects correctly during the post-instruction interview. The average number of correct responses during the pre-instruction interview was sixteen out of a total of twenty, compared to eighteen correct responses in the post-instruction interview.

All children were able to provide a more thorough rationale for the classification of the pictures after instruction. During the pre-instruction interview, more children tended to articulate one or two ideas to support the classification. During the post-instruction interview, all children were able to identify more characteristics of living and non-living objects, thus indicating the ability to examine a range of attributes from which to differentiate living and non-living objects.

During the pre-instruction interview, none of the children made the distinction between non-living and once living. The children used the term 'not-living' to refer to objects which were both non-living and once living. Following the instructional sequence, seven of the eight children could make the distinction between living, non-living and once living and could classify objects according to this criterion.

The recognition of this distinction may account for children's ability to generalize their learning in order to correctly classify examples and non-examples of living things.

Pre-instruction interview data indicated that children differentiated between living and non-living objects on the basis of the following characteristics: movement, nutritional needs, growth, death and noise production. With the exclusion of noise production, the other three characteristics represent what the children already knew in relation to living and non-living. During the post-instruction interview, children differentiated between living and non-living objects on the basis of movement, nutritional needs, growth, death and respiration. The frequency with which children identified most of the characteristics during the post-instruction interview increased as indicated in Table 4.10, with the exception of the characteristics of movement and nutritional needs.

Analysis of pre-instruction data indicated that the six year old children identified slightly more attributes of living things which they identified as characteristics of living things as compared to the five year olds. On average, the six year olds identified ten attributes of living things whereas the five year olds identified eight attributes. Following instruction, the six year old children identified thirteen attributes of living things as compared to the nine attributes identified by the five year old children.

The six year old children tended to provide a more complete rationale when classifying pictures of living and non-living objects during the Interview-About-Instances when compared to the five year olds. The six year olds classified the various examples and non-examples of living things according to combinations of attributes or characteristics, rather than classifying on the basis of a single attribute.

All eight of the children modified their original ideas of living and non-living following participation in the instructional sequence. Although all children received the same instruction, the six year old children tended to develop more complete understandings of living and non-living objects when compared to the five year olds. For the six year old children, the science topic 'Living and Non-living Objects' appears to be developmentally appropriate given that the expression of children's ideas form the basis of the instruction.

Summary

This chapter has presented the results of this research study. Comparison of the pre- and post-instruction interview data indicated that young children's conceptions of living and non-living objects were modified as a result of participation in an instructional sequence designed to promote conceptual

learning. The next chapter will summarize the data and, in turn, present conclusions and recommendations following from this research study.

CHAPTER 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter provides a summary of the study, including a summary of the instructional sequence design and the methodology used to collect the data. A synopsis is provided of the results of the data with respect to the exploration of children's conceptions of living and non-living as well as the effectiveness of the instructional sequence. Finally, research recommendations and implications for practice are suggested.

Summary of the Study

From an early age, young children develop ideas about the natural phenomena which surrounds them both through direct experience with the environment and interactions with others. These ideas and interpretations tend to differ significantly from the accepted scientific viewpoint and are often resistant to modification despite formal science instruction. This study was concerned with the exploration of five and six year old children's conceptions of living and non-living and the

development of an instructional sequence designed to modify children's existing ideas.

Clinical Interview and Interview-About-Instances

Similar to the investigations of Erickson (1979), Pines and Novak (1985) and Carey (1985) clinical interview techniques were used to probe young children's cognitive structure to reveal existing relevant prior knowledge in relation to living and non-living objects. Unlike the interviews conducted by the above mentioned researchers, this study utilized pre- and post-instruction clinical interviews to determine young children's ability to classify objects and provide justifications for the classifications. Using three open-ended questions, children were encouraged to classify a variety of living and non-living objects according to self-determined criteria. Pre-instruction clinical interview results indicated that none of the five and six year old children spontaneously classified the objects on the basis of living and non-living. During the post-instruction clinical interview, four of the eight children spontaneously classified objects on the basis of living and non-living.

The Interview-About-Instances technique, developed by Gilbert, Watts and Osborne (1985), was also used to investigate the range of concepts five and six year old children associated with the words 'living' and 'non-living'. Children classified twenty pictures as examples or non-

examples of living things and provided a rationale for the classifications. Unlike the I.A.I. technique of Gilbert, Watts and Osborne, the I.A.I. method in this study was used prior to and following instruction to determine if modification of children's ideas of living and non-living occurred as a result of participation in the instructional sequence. Analysis of pre- and post-instruction results indicated that all eight of the children modified their original ideas of living and non-living following participation in the instructional sequence. Analysis of the Case Studies revealed the nature of each child's conceptual development in relation to living and non-living.

Population and Data Collection

The population involved in this study consisted of five and six year old children from a large suburban school in Winnipeg. A random sample of eight children, four five year olds and four six year olds, participated in an instructional sequence and were interviewed both prior to and following the instruction. Of the eight children, four were female and four were male. Data were collected during a four week period from November to December, 1989.

Instructional Sequence

The instructional sequence developed for this research study was based on the Constructivist view of learning.

Fundamental to this view of learning was the notion that learning involved an active process in which each learner was engaged in constructing meanings whether from text, dialogue or physical experiences. Learning occurred not only through the taking in of new information but also through the organization and restructuring of the existing conceptions.

In teaching situations, children's conceptions influence the ways in which they respond to the material being presented - they focus on what is important to them. Despite activities aimed at promoting certain understandings, children may interact with the content in their own personal way. Therefore, instructional sequences should build upon children's intuitive conceptions to assist in the modification of these ideas toward the accommodation of scientifically accepted views. Science instruction should result in the clarification of children's existing ideas, modification of these ideas toward the scientific view and consolidation of the scientific view within the background and values of the children.

The instructional sequence developed for this research study involved a four phase approach to promoting conceptual change in relation to the five and six year old children's ideas of living and non-living objects. The instructional sequence began with an orientation activity in which children's attention and interest in living and non-living objects were aroused. The orientation activity allowed

children to become familiar with a variety of living and non-living objects while engaging in informal discussion. Through the use of open-ended questions, the researcher encouraged the children to engage in investigative play and share their observations with the other children. During the next phase, children reviewed their own ideas of living and non-living expressed during the pre-instruction I.A.I. interviews, and were exposed to the views of the other children. This elicitation phase took the form of a modified group discussion where the researcher encouraged the children to express their ideas of living and non-living. Various living and non-living objects were displayed to stimulate discussion and probe children's conceptions of living and non-living objects. The elicitation phase was followed by a restructuring phase which involved the use of the conceptual conflict strategy. Through the presentation of discrepant events and counter-evidence, the researcher attempted to assist children in the modification of their original ideas of living and non-living. The final phase, consolidation, involved the development of the scientific view being presented.

The restructuring and consolidation phases consisted of four activities, one to focus on each characteristic of living organisms as stated in the Manitoba Science Curriculum. Similar to the research of Driver, Guesne, Tiberghien (1985) and Nussbaum and Novick (1982), the activities selected for inclusion in the instructional sequence were designed to

incorporate children's existing ideas of living and non-living objects and create conceptual conflict through the presentation of discrepant events or contradictory information to the expressed ideas of the children.

Summary of Results

Children involved in this research study received science instruction on the topic 'Living and Non-living Objects' from the researcher for a period of five days, with each session designed not to exceed forty minutes. Prior to this instructional period, all eight children were interviewed using both the clinical and the Interview-About-Instances methods. After the instructional period, these children were interviewed again using the same evaluation methods.

The results of the study showed that the children's conceptions of living and non-living changed positively toward a more scientific viewpoint following participation in the instructional sequence. Data analysis indicated positive change both in children's ability to classify objects on the basis of living and non-living and in the number of correct classifications made during the Interview-About-Instances.

A second aspect of this research study focused on the effectiveness of the instructional sequence, which was based on the Constructivist view of learning. In order to analyze

its effectiveness, the main points of reference were the comparison between the points of view and the interpretations of the children's ideas of living and non-living before and after the instructional sequence. The number of correct classifications of living and non-living objects increased during the post-instruction I.A.I. interview. Since children received no feedback as to nature of their classifications during the pre-instruction interview, the increased frequency of correct responses may be attributed to the effectiveness of the instructional sequence. Analysis of pre- and post-instruction data indicated that most children identified more attributes of living things and non-living objects during the post-instruction interview when compared to the number of attributes indicated during the pre-instruction interview.

Pre- and post-instruction I.A.I. interview results further indicated that children generally experienced less difficulty classifying living objects than non-living objects. Also, following instruction, more children identified an increased number of 'scientific' characteristics of non-living objects when compared to living objects.

The instructional sequence developed for this research study was unique in that no other researcher has designed an instructional program for the topic 'Living and Non-living Objects' to be used with five and six year old children. The instructional sequence involved a four phase approach to promoting conceptual change, beginning with an orientation

activity in which children's attention and interest in living and non-living objects were aroused. During the next phase, elicitation, children reviewed their own ideas of living and non-living expressed during the pre-instruction I.A.I. interviews, and were exposed to the views of the other children. The elicitation phase was followed by a restructuring phase which involved the use of the conceptual conflict strategy. Through the presentation of discrepant events and counter-evidence, the researcher attempted to assist children in the modification of their original ideas of living and non-living. The final phase, consolidation, involved the development of the scientific view being presented.

Comparison of Results to Previous Studies

The instructional sequence developed for this study was similar to the models of learning developed by Driver, Guesne, and Tiberghien (1985) and Osborne and Freyberg (1985). Although the specific strategies were diverse, the models essentially represented frameworks for changing children's ideas and were based on the Constructivist view of learning. The researchers suggested that science instruction should begin with the elicitation of children's ideas and result in the clarification of ideas, modification of ideas toward the

scientific view and, consolidation of the scientific view within the background experiences of the children. Further, similar to the learning models of Driver, Guesne, and Tiberghien (1985) and Osborne and Freyberg (1985), the instructional sequence developed for this study employed the conceptual conflict strategy, which involved the presentation of discrepant events and counter-evidence in an attempt to increase children's awareness of the inconsistency between the scientific view and their existing frameworks.

A comparison of the results of this research study to previous studies indicated the importance of the presence or absence of facial and body features as a rationale for distinguishing between living and non-living objects. This finding supported the notion of childhood animism as identified by Piaget (1977), Looft and Bartz (1969, in Tamir et al, 1981) and Carey (1985). The overattribution of 'alive' to inanimate objects was particularly apparent in relation to the 'natural' non-living objects - water, clouds, fire, sun. However, results of this research study did not support Piaget's claim of the identification of consciousness as an attribute of living things. Of the five and six year old children who participated in this study, only one child attributed feelings and sensations to inanimate objects. During the pre-instruction interview, the child classified the picture of the airplane as a living thing and indicated that the plane could 'go anywhere it wants'. The identification

of consciousness did not occur during the post-instruction interviews.

Similar to the findings of Carey (1985), this study did not reveal sufficient evidence to support Piaget's characterization of stages in the development of the 'life' concept. Children did not tend to utilize single criterion justifications for the classification of living and non-living objects. Children distinguished between living and non-living objects according to combinations of attributes or characteristics, rather than classifying on the basis of a single attribute.

Tamir et al (1981), investigated the prevalence of animistic notions among intermediate and junior high students. General findings indicated that movement was the most popular indicator for distinguishing between 'alive' and 'not alive'. Results from the present study partially support the research conclusions of the Tamir et al investigation. During the pre-instruction interview, all children identified movement as the main characteristic of living things. However, following instruction, nutritional needs, movement and growth emerged as the indicators for distinguishing between living and non-living objects.

Carey (1985), investigating children's conceptions of life, concluded that young children did not represent the concept 'living thing' with the same extension as the 'scientific' concept, subsuming animals and plants in a single

category. According to Carey none of the four to seven year old children judged all animals and plants to be alive but not any inanimate objects. Contrary to the conclusions drawn by Carey, results of this research study indicated that two six year old children, during the post-instruction interview, judged all plants and animals and no inanimate objects to be alive. Carey further observed that young children who denied life to inanimate objects also denied that plants were alive. Results of this research study indicated that three of the eight children denied life to inanimate objects but indicated that plants were alive. The type of plant represented for classification as an example or non-example of a living thing, tended to determine if life was attributed to the plant. Seven of the eight children correctly classified the flower and the tree as examples of living things. When asked to classify the mushroom as a living or non-living object, three of the eight children indicated that the mushroom was non-living. With probing, it was revealed that these children had limited experience with mushrooms as living things.

In contrast to the findings of this research study, Lawson (1987) suggested that children come to the learning of concepts in the life sciences as 'blank slates'. Based on his own research using a sample size of three children, aged six, nine and ten, Lawson concluded that children hold few personally derived, alternative conceptions due to the complexity of biological concepts. This view expressed by

Lawson is in opposition to the view of Mintzes (1989). Young children, according to Mintzes, construct meanings from all forms of personal experience and possess a meaningful learning set which allows for naive theory construction within the physical as well as life sciences realm. Mintzes suggested that elaboration of children's intuitive ideas within the life sciences generally occurred in the school environment and was accompanied by the emergence of a new repertoire of concepts which reflected a more 'scientific' viewpoint.

Although not indicated as a characteristic of living things by other researchers, respiration was identified as such by three of the children during the pre-instruction interview. All three referred to respiration when identifying the fish as a living thing. Perhaps this finding can be attributed to the fact that breathing in animals and plants is automatic and not noticeable. Therefore, children tended to overlook respiration as a characteristic of living things. The fish, however, represented a novel and observable form of respiration which children could identify. During the post-instruction interview, respiration was identified as a characteristic of living things by five of the eight children.

Conclusions

The original rationale for this study was based on several critical issues in science education. Children bring to the study of science ideas which are coherent and sensible from their point of view and which have been successful for them in explaining scientific phenomena they have observed. These ideas and interpretations however, differ significantly from the accepted scientific viewpoint and are often resistant to modification despite formal science instruction. This recognition of children's conceptual frameworks provided support for the need to elicit children's ideas about scientific phenomena prior to science instruction. Further, the recognition that children's pre-instructional ideas can play an interfering role in the learning of science concepts was also supported. Science educators such as Clough and Driver (1986) stated the necessity to take into account the ideas and beliefs children bring to their formal study of science, if ideas are to be successfully modified by instruction.

This research study found that the elicitation of children's ideas prior to science instruction and the identification of general patterns in the children's expressed ideas, allowed for the development of an effective instructional program designed to promote conceptual learning. The instructional sequence, based on the Constructivist view

of learning, involved a four phase approach to modifying five and six year old children's ideas of living and non-living objects. The orientation phase allowed for the exploration of living and non-living objects and informal discussion of ideas. This period of exploration also served as a means to stimulate children's interest in the topic 'Living and Non-living Objects'. The elicitation phase involved the exploration of children's conceptions of living and non-living objects through the implementation of both the clinical interview and the Interview-About-Instances techniques. Group discussion allowed children to review their own ideas of living and non-living expressed during the interviews, and reflect upon the expressed views of others. The restructuring and consolidation phases were comprised of science activities which presented children with counter-evidence to encourage an awareness of the inconsistency between the scientific viewpoint being developed and the children's existing conceptions. The implementation of this approach resulted in the elaboration and modification of children's original ideas toward a more scientific understanding of living and non-living objects.

Since the development of the instructional sequence was effective in the manner stated above, it would be reasonable to conclude that similar programs can be successfully designed. Further, it may be concluded that such programs can be effectively correlated with existing curricula in an effort

to need local needs. The instructional sequence was found to be effective as a means of learning and teaching science concepts, since the concepts presented in the Manitoba Science Curriculum Guide were focused upon throughout the instructional program.

The development and use of clinical interview techniques such as those designed for this research study have indicated that these evaluation methods can be used effectively at the primary school level. The review of literature presented in Chapter Two and the 'Justification of Methodology' discussed in Chapter Three indicated that the interview represents a superior evaluation measure for investigating cognitive structure, especially for young children.

In as much as the original rationale for this research study stated that conceptual learning could be enhanced through the implementation of an instructional sequence designed to modify children's ideas in relation to living and non-living, this rationale has been substantiated by the findings of this research study.

Research Recommendations

It is recommended that further study be undertaken to attempt to identify the effectiveness of the above mentioned approach to science instruction generally. It may be

worthwhile to conduct a research study which attempts to identify the effectiveness of this approach to science teaching to the Kindergarten and Grade One levels over a longer intervention period. Such a study would reveal the long term modification of children's science concepts. Further, a control group could be introduced to determine the significance of maturation over a longer period of time.

Replication of this study with other populations and larger samples would contribute to the generalizability of results. The use of a control group may help to determine the effectiveness of the instructional sequence.

Research on the development of further evaluation measures for the purposes of identifying changes in children's cognitive structures would be beneficial to educators.

Implications For Practice

The instructional sequence developed in this study through the elicitation of ideas prior to instruction, was intended to modify young children's conceptions of living and non-living objects. Further studies are required to develop and implement instructional programs which emphasize this approach to science instruction, especially in the early formal schooling years. Efforts must also be made to design such programs which correlate to existing science curricula.

Efforts are also required for the development of teachers' guide material which set out clear frameworks for the teaching of classroom activities. Wherever possible, guidelines for teacher roles and instructional strategies need to be suggested alongside the details of the proposed lesson activities.

Further efforts should be made in the area of curriculum development. Results from this research study could be used to provide curriculum guidelines as to specific teaching strategies which might enhance student learning and suggestions for the sequencing of activities within the development of science concepts. This study revealed the importance of the placement of science concepts within the curriculum to ensure that the specific content is developmentally appropriate for the children. Comparison of the five and six year old's conceptions of living and non-living objects indicated that with the same instruction, the six year old children tended to develop more complete understanding of the concepts 'living' and 'non-living' and 'once alive'.

Summary

This final chapter has presented a summary of results, conclusions, practical applications and research suggestions

regarding this study of young children's conceptions of living and non-living objects and the implications for teaching. These findings have been presented in an effort to further enhance educators' understanding of the nature of children's ideas in science and the implications of implementing instructional programs which promote conceptual learning.

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APPENDIX A

INTERVIEW-ABOUT-INSTANCES TRANSCRIPTS

TRANSCRIPTION OF PRE-INSTRUCTION INTERVIEWS

Subject A

card # 1 (boy)

I- is this a picture of a living thing

A- yeah

I- how do you know

A- cause it's a person

I- is there anything about the person that helps you know he is living

A- no

I- you're a person are you living

A- yeah

I- how do I know that you're living

A-..I don't know

I- do you do anything that would help me to know that you are living

A- I'm my Mom's big helper around the house

I- do you need anything to help you live

A- I don't know

card # 2 (cat)

I- is this a picture of a living thing

A- yeah

I- how do you know

A- cause..I don't know

I- does it do anything to help you know that it's living

A- yeah it moves around the house

I- can it do anything else

A- (no response)

I- do cats need anything

A- food

I- anything else

A- no

card # 3 (bird)

I- is this a picture of a living thing

A- yeah

I- how do you know

A- ..cause it can fly

I- can it do anything else does it need anything to help is stay alive

A- food

I- anything else

A- I don't know

card # 4 (worm)

I- is this a picture of a living thing

A- yes

I- how do you know

A- cause it can squirm around
I- anything else
A- no

card # 5 (flower)

I- is this a picture of a living thing
A- yeah
I- how do you know
A- cause it can grow
I- does it do anything else
A- no
I- do you remember the other pictures we looked at do any of these grow
A- yeah the boy, a cat. a worm and a flower
I- was there anything else you wanted to tell me about the flower
A- no

card # 6 (fish)

I- is this a picture of a living thing
A- yes
I- how do you know
A- cause it can swim
I- can it do anything else
A- no
I- what did you tell me the flower can do
A- grow..the fish can grow and the flower can grow the worm the bird
I- anything else
A- no

card # 7 (trees)

I- is this a picture of a living thing
A- hum no yes
I- how do you know
A- cause they can grow
I- can they do anything else
A- .. they need water
I- do you know how you water trees
A- no
I- where do you put the water
A- beside the tree
I- how does the water get inside the tree
A- cause it sinks down into the grass and goes up into the tree and gets to all the leaves and everything
I- do you know how the water gets up the tree
A- hum no

card # 8 (mushroom)

I- is this a picture of a living thing
A- no (laugh)
I- how do you know

A- it grows but people cut it down
I- people can cut a tree down and does that make the tree non-living
A- it doesn't make it living
I- when is a mushroom living
A- in the summer
I- so the mushroom can live in the summer when is the mushroom non-living
A- when the winter comes
I- what happens to it then
A- well the snow covers it up till the spring time and the summer
I- during the winter time what would you say about the mushroom
A- it's not living
I- you also mentioned you could cut the mushroom
A- yes
I- then what would you say about the mushroom
A- it's not living
I- what if you saw a mushroom in the ground what would you say about it
A- it was living

card # 9 (car)

I- is this a picture of a living thing
A- (laugh) no
I- how do you know
A- cause it's a car it doesn't grow
I- is there anything else that helps you know it's non-living
A- cause people can tell it where to go and then when people tell it where to go it goes
I- could it go all by itself
A- no
I- does the car need any of the things that you need
A- it doesn't need food but the thing that it needs is oil and gas

card # 10 (rock)

I- is this a picture of a living thing
A- no
I- how do you know
A- cause it can't grow or uhm it doesn't need food or water like any other trees
I- anything else about the rock
A- no

card # 11 (TV)

I- is this a picture of a living thing
A- no (laugh)
I- how do you know
A- people tell at the TV place tell it what to do and when people plug it in they see what the people at the TV station

is showing is showing at their TV station
I- is there anything else
A- it doesn't need food but it needs oil that's the only
thing I know

card # 12 (sun)

I- is this a picture of a living thing
A- hum no
I- how do you know
A- cause it can shine on people and make the flowers grows
it can make the mushrooms grow and make the trees grow
I- is there anything else about the sun that helps you know
it is non-living
A- well it can make other things grow but and it can make it
grow too it can make it more brighter
I- does that make the sun a living thing or a non-living thing
A- living thing

card # 13 (top)

I- is this a picture of a living thing
A- no
I- how do you know
A- cause it's a toy
I- what do you know about toys
A- well..cause other people or kids play with them

card # 14 (egg)

I- is this a picture of a living thing
A- no
I- how do you know
A- cause people break it and make it into food and the shell
breaks and people throw it in the garbage
I- what if there was a chick inside
A- well then would be a baby chick in the egg and hens would
lay it and out would come a baby chick
I- if there was a baby chick in the egg would you say the egg
is living or non-living
A- non-living
I- you still would saw it's non-living
A- right
I- so the egg to you is always non-living
A- right

card # 15 (clouds)

I- is this a picture of a living thing
A- no
I -how do you know
A- cause they pour water on the ...cause they make the trees
grow they make the mushrooms grow and the flowers grow
I- what about the clouds

A- not living
I- is there anything else that helps you to know the clouds are non-living
A- nope

card # 16 (jack-in-the-box)

I- is this a picture of a living thing
A- no it's a toy
I- how do you know it's non-living
A- cause it is a toy kids play with them and when they turn a little handle he pops up
I- if he pops up he is able to move you told me a lot of living things move
A- but hum it doesn't grow

card # 17 (fire)

I- is this a picture of a living thing
A- (laugh) no it's a fire
I- how do you know the fire is non-living
A- ca-u-s-e I don't know

card # 18 (jet)

I- is this a picture of a living thing
A- no
I- how do you know
A- cause it flies people where they want to go and to which city they have to go instead of their own city that they live in
I- anything else about the plane

card # 19 (seed)

I- is this a picture of a living thing
A- no
I- how do you know
A- cause.. I don't know I don't know
I- have you ever planted seeds
A- no
I- do you know what happens to seeds when you plant them
A- they grow
I- how could the seed grow if it's non-living
A- ..it's living changed my mind
I- why is the seed living
A- well..I don't know

card # 20 (water)

I- is this a picture of a living thing
A- no
I- how do you know
A- well it washes people's hands dishes and hum..people that have plants water plants too
I- is water living or non-living
A- non-living

definitions:

living - it grows, it needs food, it moves

non-living - well they can't eat, can't grow

Subject B

card # 1 (boy)

I- is this a picture of a living thing

B- yes

I- how do you know

B- because it's a boy and it lived in a house

I- is there anything else that helps you to know the boy is a living thing

B- because because I don't know why

I- no other ideas

B- no I don't have any other ideas

card #2 (cat)

I- is this a picture of a living thing

B- yes

I- how do you know

B- because it's cause I don't know why I keep forgetting oh yeah because it lives in a house

I- things that live in a house are living

B- yeah right

I- is there anything else that helps you know the cat is living

B- nope..cause it moves and all that

I- the cat is able to move what about the boy

B- he can still move too that's why he still lives but if he is dead he can't of if he's dying

card # 3 (bird)

I- is this a picture of a living thing

B- yes

I- how do you know

B- cause it moves and it flies that's why

I- does anything else tell you that it's living

B- nope it doesn't tell me anything oh yeah cause it lives in a tiny bird house

card # 4 (worm)

I- is this a picture of a living thing

B- yes..under mud

I- how do you know the worm is living

B- because let me think because it lives in the..I don't know what do you think
I- does the worm do anything that helps you know it's living
B- yeah because it moves and all that
I- does it need anything to help it stay living
B- food

card # 5 (flower)

I- is this a picture of a living thing
B- but it doesn't live
I- it's not living
B- yeah it lives
I- is it a living thing or a non-living thing
B- it's not a living thing because it doesn't move or anything
I- so you think it is not a living thing does anything else about the flower help you to know it's non-living
B- nope..you need water to make it grow and I don't know what else you need but you need water to make it grow though
I- if it grows is it living or non-living
B- living
I- so what are we going to say about the flower is it living or non-living
B- living
I- so you've changed your mind to say it is a living thing and why is it living
B- because uhm I think it's living because uhm cause it doesn't look brown
I- are some flowers brown
B- when they're dead and go to heaven

card # 6 (fish)

I- is this a picture of a living thing
B- yes
I- and how do you know
B- cause it's a fish
I- how do you know it's living though
B- (sigh) I just do
I- can you tell my why the fish is a living thing
B- cause because it moves
I- does it do anything else that helps you know it's living
B- yeah it eats food but when someone fishes and somebody catches it it can't move cause someone will like to eat it
I- what would happen to the fish after it is caught
B- it would die

card # 7 (trees)

I- is this a picture of a living thing
B- yes
I- how do you know
B- cause it's a tree
I- how do you know trees are living
B- because I just do because I know why cause I know very much

about trees because when they look green they aha are living
but they're brown when they're dying
I- what can you tell me about the trees outside now
B- they are brown the trees are not living because they
stopped growing
I- does that mean they are non-living
B- yes
I- when they are green what do we know about trees
B- ..they live

card # 8 (mushroom)

I- is this a picture of a living thing
B- no
I- how do you know
B- it's for eating you get to eat it
I- is there anything else you know about a mushroom that helps
you to know it's non-living
B- because it is a plant and it's a vegetable
I- are plants and vegetables living things
B- no only plants are living not vegetables
I- the mushroom is a vegetable
B- yes
I- so you say it is non-living
B- yeah I'm not going to say that it's going to live I'm
going to say it's not going to live
I- it is non-living any other reason why the mushroom is not
a living thing
B- no I can't think of anything more

card # 9 (car)

I- is this a picture of a living thing
B- no
I- how do you know
B- because it just moves around and drives to places and all
that
I- can the car move like you can
B- no because they move the same as me but they just go faster

I- is there anything else you wanted to tell me about the car
B- no thanks

card # 10 (rock)

I- is this a picture of a living thing
B- nothings about that
I- is the rock a living thing
B- uhm nope but I don't know anything about it
I- you think the rock is non-living why do you have that idea
B- I just have it in my mind
I- well think about something that is living like the fish
what's different between the rock and the fish
B- one's moving and one's not
I- which one is not moving

B- the rock
I- so what does that help you know
B- that the fish is moving and the rock is not
I- would you say that the rock is a living thing or a non-living thing
B- it's not a living thing

card # 11 (TV)

I- is this a picture of a living thing
B- no
I- how do you know
B- cause it's a TV and it's electric
I- oh is there anything else you know about a TV
B- nope

card # 12 (sun)

I- is this a picture of a living thing
B- yes it's a sun
I- how do you know the sun is a living thing
B- because I just do because because cause it's bright and all that
I- anything else that helps you know it's living
B- no I don't think so

card # 13 (top)

I- is this a picture of a living thing
B- no cause it's a top and it spins around
I- it's not living
B- no
I- how do you know
B- I just do because I know it and aha it's not a living thing to me

card # 14 (egg)

I- is this a picture of a living thing
B- no
I- the egg is non-living
B- yeah because it just cracks and you eat it
I- what would you think though if there was a chick inside
B- I don't know
I- would the egg be a living thing or a non-living thing
B- living thing
I- so the egg would be living if there was a chick inside
B- yes
I- when is the egg a non-living thing
B- when when they don't sit on it cause if I sat on one it will hatch into one right but that only happens with chickens
I- (laugh)
B- how does that happen with them because they get warm
I- warmth is very important
B- I'll have to put it under my pillow
I- instead of in the fridge and what do you think will happen

B- it will turn into a chicken
I- there is a little bit of a difference between the kind you eat and the kind of egg that has a chicken in it
B- right
I- the kind that has a chicken in it has been fertilized and it is growing a tiny chick inside the eggs that you eat haven't been fertilized so there is no chick inside
B- yeah right
I- was there anything else you wanted to tell me about the egg
B- no

card # 15 (clouds)

I- is this a picture of a living thing
B- clouds that's nothing to do about it
I- are clouds living things
B- living
I- how do you know that
B- I don't know I don't think anything else

I- do clouds do anything that help you know they are living things
B- no..yeah because they move
I- anything else that helps you know clouds are living
B- no not to me

card # 16 (jack-in-the-box)

I- is this a picture of a living thing
B- jack-in-a-box that's nothing
I- is this a living thing or a non-living thing
B- no no it has nothing to do
I- how do you know the jack-in-the-box is non-living
B- because when you wind it up it just pops out
I- but that's moving isn't it I thought you said living things move
B- but that doesn't even move it doesn't
I- so popping is different from moving
B- yeah popping is..cause it doesn't move at all
I- it only moves how
B- ..it just pops and wiggles
I- and that's a different type of moving
B- yeah

card # 17 (fire)

I- is this a picture of a living thing
B- no
I- how do you know
B- because it just burns out and it turns into smoke
I- anything else you wanted to tell me about the fire
B- nope

card # 18 (jet)

I- is this a picture of a living thing

B- no
I- how do you know
B- cause it just flies
I- isn't that moving
B- no
I- how is that different
B- yeah because I move like this and planes just move cause this is not a living thing it's really not because it flies up in the sky
I- a bird flies up in the sky but you told me it was a living thing
B- but this is not
I- how do you know
B- because it just flies away and does nothing it doesn't talk that's why
I- it can't talk any other ideas
B- no not to me

card # 19 (seed)

I- is this a picture of a living thing
B- no because it grows into a peach tree but it lives
I- does it live
B- yeah but not when it's like this
I- you're saying that when it's a seed it's non-living but then what happens to it
B- when you plant it and water it it starts to grow
I- when it starts to grow we would say it's
B- living

card # 20 (water)

I- is this a picture of a living thing
B- yes because no because it's just water running
I- how do you know water is non-living
B- because it's just water draining
I- it's just the water draining and it's a non-living thing
B- no

definitions:

living: I think it moves, and it eats and it sleeps and it goes to school not all living things
non-living: people in heaven and this frog here. The frog dried out and it died and it's in heaven

Subject c

card # 1 (boy)

I- is this a picture of a living thing
C- yeah
I- how do you know the boy is living
C- because because it's supposed to be

I- how do you know the boy is living
C- because he is a boy..aha
I- does he do anything that helps you know he's a living thing
C- aha I don't know he plays with toys and he needs a house
I- he needs toys, he needs a house does he need anything else
C- aha he needs to feel good
I- what does he need to help him feel good
C- medicine you know what my vitamin C is all done
I- oh is it you might have to get some more was there
anything else you wanted to tell me about the boy
C- aha aha I don't know

card # 2 (cat)

I- is this a picture of a living thing
C- yeah
I- how do you know
C- because a boy has the cat and the cat needs food
I- a cat needs food does it need anything else
C- toys
I- does the cat do anything to help you know it's a living
thing
C- aha aha no

card # 3 (bird)

I- is this a picture of a living thing
C- no
I- how do you know
C- because I saw one outside and it didn't live it flies
I- it is able to fly but it is non-living
C- no
I- what else tells you that the bird is non-living
C- I don't know
I- so you're telling me that the bird is not like the cat
C- no
I- the cat is living the bird is non-living
C- no it lives outside
I- you say the bird lives outside
C- yeah in a nest
I- is it a living thing or a non-living thing
C- not a living thing
I- I'm not quite sure I understand why the cat is living and
the bird is not what else tells you the bird is non-living
C- because it's supposed to stay outside
I- so you're telling me that things that live outside are non-
living
C- no
I- is that what you think
C- yeah

card # 4 (worm)

I- is this a picture of a living thing
C- no

I- how do you know
C- because aha.cause cause it crawls around and it goes under water
I- the worm crawls around and goes under water does that mean it is a living thing or a non-living thing
C- not a living thing
I- did you want to tell me any more about the worm
C- no I'm finished that

card # 5 (flower)

I- is this a picture of a living thing
C- no it stays outside in a garden
I- ok can you tell my more about why it isn't living
C- aha uhm
I- can a plant do anything or does it need anything
C- it needs food.he needs..water to make it grow
I- it needs water and it grows is the flower a living thing or a non-living thing
C- not a living thing
I- why is the flower non-living
C- because it stays in the garden and somewhere in the grass
I- what about this plant it isn't in the garden is it living or non-living
C- it's living
I- and why is this plant (house plant) living
C- because when anybody needs you put water inside the plant to make it grow too just like this flower
I- o.k. what makes this flower non-living and this one living
C- uhm
I- how do you tell the difference
C- I'm finished with that one

card # 6 (fish)

I- is this a picture of a living thing
C- no
I- are you looking at the real fish as well is the fish a living thing or a non-living thing
C- it is
I- how do you know
C- because because it needs food to stay healthy and to grow bigger and fatter
I- it needs food and it grows does it need anything else
C- no

card # 7 (trees)

I- is this a picture of a living thing
C- uhm hum
I- how do you know
C- because you have to get a plant and put some water in the plant to make it grow into a tree
I- a tree is a living thing
C- yes

card # 8 (mushroom)

I- is this a picture of a living thing

C- it is living

I- how do you know

C- because.it's got magnets inside the mushroom

I- do all mushrooms have magnets

C- yeah

I- what do you know about mushroom where have you seen them

C- yeah aha I saw some when I met Auntie Julie

I- and where did you see these mushrooms

C- aha.aha.hum. I don't know

I- is the mushroom a living thing or a non-living thing

C- it is living

I- you said it was living because it has magnets

C- yeah

I- do you have magnets

C- yeah on our fridge

I- are you a living thing

C- yeah

I- do you have magnets on you

C- no

I- and you're living

C- yeah

I- and you're saying the mushroom is living but it has magnets

C- yeap but not me (laugh)

I- but you don't does the cat have magnets

C- no

I- does the mushroom have magnets

C- yeah

I- the magnets make it a living thing

C- uhm hum it grows

I- the mushroom is able to grow

C- yeap

I- do you know anything else about mushrooms

C- no

card # 9 (car)

I- is this a picture of a living thing

C- it is a living thing because it lives in a garage

I- the car is living

C- yeah because it lives in a home

I- is there anything else that helps you know it's living

C- because it drives it drives, because the lights go on

I- anything else you want to tell me

C- nope

card # 10 (rock)

I- is this a picture of a living thing

C- no

I- how do you know

C- because rocks don't live they only stay.I don't know

I- you had an interesting idea tell me more
C- aha.u-h-a I don't know
I- does the rock need anything like you do remember you are
a living thing
C- yeah but this is not a living thing.it stays where it's
supposed to stay
I- oh it just stays
C- it stays where it's supposed to stay
I- are you like that
C- no
I- what are you able to do
C- I'm able to play with toys
I- is there anything else you wanted to tell me
C- no

card # 11 (TV)

I- is this a picture of a living thing
C- yeap it's a living thing because it lives in the house
I- how do you know
C- because you got to watch TV you watch on the TV
I- the TV is a living thing
C- yeah
I- it's living like you are
C- yeah
I- tell me why it's living
C- hum hum (sigh) aha
I- how do you know the TV is living
C- because there is a plug for it and you turn it on with a
switch
I- do you have a plug and a switch on you
C- no but the TV does cause look at the plug
I- does that make it a living thing
C- yeah
I- but you don't have a plug and a switch on you
C- nope but this one has a switch to turn on the TV
I- when the TV is off is it a living thing or a non-living
thing
C- aha must be aha it's supposed to be living

card # 12 (sun)

I- is this a picture of a living thing
C- no the sun is bright
I- how do you know the sun is non-living
C- because the sun is bright outside
I- what else helps you know it's non-living
C- nothing

card # 13 (top)

I- is this a picture of a living thing
C- yes it's a living thing
I- how do you know
C- because it spins around and it.uhm

I- it spins around is there anything else that helps you know it's living
C- no

card # 14 (egg)

I- is this a picture of a living thing

C- no

I- how do you know

C- because...

I- do you have any ideas about the egg

C- no I don't have any ideas

I- you're not sure why it's non-living

card # 15 (clouds)

I- is this a picture of a living thing

C- no

I- how do you know

C- because the rain is coming out of the clouds

I- is there anything else that tells you clouds are not living

C- ...aha (sigh) no

card # 16 (jack-in-the-box)

I- is this a picture of a living thing

C- yes (laugh)

I- how do you know

C- because it's a toy

I- toys are living things

C- yeah..

I- it lives like you do

C- yeap it lives in a toy box

I- you think it's a living thing because it lives in a toy box

C- yeah

card # 17 (fire)

I- is this a picture of a living thing

C- yeah..what about a fireplace

I- is fire a living thing

C- uhm sometimes

I- when is fire a living thing

C- uhm..(sigh)

I- any ideas

C- (no response)

I- when is it non-living

C- because...(no response)

card # 18 (jet)

I- is this a picture of a living thing

C- no

I- how do you know

C- because it flies

I- because it flies does that mean it is non-living

C- I changed my mind
I- what is you're idea now
C- it does live
I- you think the plane is living
C- it lives in a airport yeah

card # 19 (seed)

I- is this a picture of a living thing
C- yes
I- how do you know
C- because...
I- because why
C- hum...hum
I- what's you're idea about that
C- I don't know

card # 20 (water)

I- is this a picture of a living thing
C- yes
I- how do you know
C- because it lives in the bathtub
I- and that's how you know it's a living thing
C- yeap

definitions:

living: I think of a motorcycle because it drives
and turns like a car. I play with toys.

non-living: I don't know. Things that stay
outside.

Subject D

card # 1 (boy)

I- is this a picture of a living thing
D- yes it's a boy
I- how do you know the boy is living
D- because he talks and he moves his legs uhm
I- is there anything else you wanted to tell me
D- no

card # 2 (cat)

I- is this a picture of a living thing
D- yes
I- how do you know
D- well because it meows and hum his tail moves
I- does the cat do anything else or need anything which helps
you know it's a living thing
D- I don't think so

card # 3 (bird)

I- is this a picture of a living thing

D- yes

I- how do you know

D- cause it's a bird and it flies but if it's dead it just stays on the ground and they build nests with their feet hum..nothing else

card # 4 (worm)

I- is this a picture of a living thing

D- yes

I- how do you know

D- well cause it moves slowly around and hum.hum..

I- anything else

D- no

I- you said it moves slowly can you think of anything else

D- no

card # 5 (flower)

I- is this a picture of a living thing

D- yeah

I- how do you know

D- well it grows when people plant the flowers it just has a little seed and if you put water on it then it will grow

I- so the flower is a living thing

D- yes

I- did you want to tell me anything else about it

D- no

card # 6 (fish)

I- is this a picture of a living thing

D- yes

I- how do you know

D- well because it moves a round slowly in the water like that fish right there and it moves he's got a little mouth that goes (opens and closes mouth) like that and eh

I- do you know what the fish is doing when he moves his mouth like that

D- not talking probably

I- is there anything else about the fish that helps you to know it's a living thing

D- well it moves it's tail when it comes out of water it probably gets dead after a while

I- so it needs to be in the water

D- yes

card # 7 (trees)

I- is this a picture of a living thing

D- yes

I- how do you know

D- well cause it's well when God made trees well he just planted them and they grew into lots of trees like this one

looks like a Christmas tree but it isn't and these are just plain trees

I- is there anything about trees to help you know they are living

D- yeah cause there's leaves growing on them if they were dead then there was no leaves on them

I- what about the trees outside now do they have leaves on them

D- no not really

I- are they living things or non-living things

D- real

I- they are real are they living

D- not right now they are hibernating

I- you thinks they are still living

D- yes

card # 8 (mushroom)

I- is this a picture of a living thing

D- yes

I- how do you know

D- hum.cause when hum people plant mushrooms they grow and they get to be round like this kind and it gets spots on there and lots of things like that

I- anything else about a mushroom

D- no

card # 9 (car)

I- is this a picture of a living thing

D- no

I- how do you know

D- cause it doesn't talk or do anything except when people drive it it's tires move around

I- anything else that helps you know the car is non-living

D- no..yeah it doesn't have eyes or it doesn't have a mouth or it doesn't have a nose it can't breathe or anything

card # 10 (rock)

I- is this a picture of a living thing

D- no

I- how do you know

D- cause it doesn't move unless some people pick it up or anything

I- anything else that helps you to know the rock is non-living

D- ..no

card # 11 (TV)

I- is this a picture of a living thing

D- no

I- how do you know

D- cause it doesn't speak unless somebody turns it on and it has to be plugged in

I- anything else
D- nope

card # 12 (sun)

I- is this a picture of a living thing
D- yes
I- how do you know
D- well cause it shines on people when it's hot outside
I- it there anything else you wanted to tell me
D- no

card # 13 (top)

I- is this a picture of a living thing
D- no
I- how do you know
D- well unless uhm no cause it doesn't speak or anything and it moves only if somebody pulls it around
I- so can it move by itself
D- no unless somebody picks it up and moves it
I- anything else
D- nope

card # 14 (egg)

I- is this a picture of a living thing
D- yes
I- how do you know
D- well cause uhm a duck or something hatched it and then the egg gets a little chicken in there or something
I- what if this was an eating egg
D- well some people would have to crack it up and do something with it
I- if it was an eating egg would it be a living thing or a non-living thing
D- well I don't really know that question well maybe it will be not a living thing
I- so when is the egg a living thing
D- unless a mother duck hatches it
I- when is the egg non-living
D- when it's an eating egg

card # 15 (clouds)

I- is this a picture of a living thing
D- yes
I- how do you know
D- well cause it lets out rain and God created everything
I- so clouds are living because they let off rain
D- yes
I- anything else
D- not for me

card # 16 (jack-in-the-box)

I- is this a picture of a living thing

D- no

I- how do you know

D- well cause it doesn't move unless somebody picks it up and twirls it around and then it pops open

I- anything else

D- no

I- you said earlier that living things have eyes and nose and mouth they have faces

D- yeah but yeah but that one is a toy

I- are you saying that just because something has a face it does not mean it is living

D- yes

card # 17 (fire)

I- is this a picture of a living thing

D- hum yes

I- how do you know

D- well hum people made it cause they just need a match to light it and paper and just let it go

I- when the fire is burning it is a living thing

D- yes

I- is there anything else you can tell me about the fire

D- nope

card # 18 (jet)

I- is this a picture of a living thing

D- yes

I- how do you know

D- well somebody drives it and then it goes wherever it wants it to well if you want to go to the left you just pull this left and if you want to go right you just go right

I- so you think the plane is a living thing

D- yes

card # 19 (seed)

I- is this a picture of a living thing

D- hum no

I- how do you know

D- cause it doesn't move unless somebody picks it up and puts it in the garbage when they've had a peach of something

I- you were telling me about seeds before when we were looking at the picture of the trees and you said you could do something with seeds

D- hum.let me think you can bury them and make them grow

I- could you do that with a peach seed

D- no

I- why not

D- cause it isn't a seed like a seed that makes plants and stuff like that it's a peach seed and that's why it doesn't grow or anything

I- what do you do with your peach seeds when you're finished with them
D- throw them in the garbage or use them for something

card # 20 (water)

I- is this a picture of a living thing
D- yes
I- how do you know
D- well cause it..well if somebody turns it on the tap on then it will pour water out and if you put it on fast and you're in somebody else's room and then if it overflows then you'll have to get out of the house
I- is water living just like you are
D- no
I- is water a living thing or non-living thing
D- hum I don't really know but it doesn't have a face
I- what are we going to say about water is it a living thing or a non-living thing
D- non-living

definitions:

living - people are alive. People can move around. If you had a bean seed and you wanted to plant it somewhere you would have to dig with your hand and put it in the ground you'll have to pour water over it.

non-living - they won't move or they won't talk.

Subject E

card # 1 (boy)

I- is this a picture of a living thing
E- yes
I- how do you know
E- because it's standing
I- o.k. the boy is standing does anything else tell you that he is living
E- no response

card # 2 (cat)

I- is this a picture of a living thing
E- yes
I- how do you know
E- ...because I just know
I- does it do anything to help you know it's living
E- ..not in the picture
I- if we had a real kitten sitting here on the table how would you know it was a living thing

E- .cause it would go meow
I- it might make a noise what else might it do
E- move it's paw
I- move it's paw would it do anything else
E- I don't know

card # 3 (bird)

I- is this a picture of a living thing
E- no response
I- is a bird a living thing
E- yes
I- how do you know
E- ..cause it's wings are out, it can fly
I- anything else
E- no response
I- does the bird need anything to help it stay living
E- it needs bird food
I- what do you need to help you stay living
E- food and drinks

card # 4 (worm)

I- is this a picture of a living thing
E- uhm hum
I- how do you know
E- (yawn)...no response
I- does it do anything that any of these other living things do
E-I never saw a worm before
I- but you think it's a living thing do you have any ideas why you think it's a living thing
E- it can squirm
I- did you want to tell me anything else about the worm
E- no

card # 5 (flower)

I- is this a picture of a living thing
E- ..yes
I- how do you know that
E- because it's blossoming
I- it's blossoming does anything else tell you that it's living
E- no response

card # 6 (fish)

I- is this a picture of a living thing
E- yes
I- how do you know
E- ..no response
I- look at our own fish
E- he can move his wings
I- what is he doing right now
E- sucking on the side of the bowl

I- do you know why he might be doing that
E- he is trying to get food
I- fish need food does he need anything else
E- no
I- did you want to tell me anything more about the fish
E- no

card # 7 (trees)

I- is this a picture of a living thing
E- ..yes
I- how do you know
E- because it has so much green on it
I- how else do you know the trees are living
E- they need water
I- do you know where the water goes
E- into it's roots
I- where are the roots
E- under the ground
I- so the water goes into the roots and then where does it go
E- into the plant
I- what would happen if the tree didn't get water
E- it would die
I- is there anything else you can tell me about trees
E- no

card # 8 (mushroom)

I- is this a picture of a living thing
E- uhm hum
I- how do you know
E- ..cause it's standing up
I- anything else
E- no
I- is it like the tree in any way
E- no
I- but you think they are living things
E- yes

card # 9 (car)

I- is this a picture of a living thing
E- ..no
I- how do you know
E- because cars don't have because..I don't know
I- you had an idea what were you thinking of
E- no response
I- is the car like you can it do the things you do does it
need the things you do
E- no
I- can you tell me a little more about that
E- no I just know..cause my Dad told me

card # 10 (rock)

I- is this a picture of a living thing

E- yes

I- how do you know

E- ...(sigh)..I don't know

I- is the rock similar to the fish

E- no response

I- is the rock a living thing or a non-living thing

E- living

I- can you tell me why you think that

E- no

card # 11 (TV)

I- is this a picture of a living thing

E- no

I- how do you know

E- because it doesn't move..doesn't need food

I- anything else

E- no

card # 12 (sun)

I- is this a picture of a living thing

E- yes

I- how do you know

E- uhm..because if the sun wasn't alive it wouldn't shine as much

I- you think that because the sun shines it is a living thing anything else about the sun that helps you to know it's living

E- no

card # 13 (top)

I- is this a picture of a living thing

E- (yawn) ah ah (no)

I- how do you know

E- it doesn't need food

I- anything else that helps you to know it is a non-living thing

E- no

I- can it move

E- yes

I- does that make it a living thing

E- yes

I- so is it living or non-living

E- not living

I- even though it can move

E- yes

I- does it move the same way you can move

E- it moves in a different way because it just turns around and it doesn't go anywhere

I- so the top moves differently

card # 14 (egg)

I- is this a picture of a living thing

E- yes

I- how do you know

E- there might be chicks in it

I- anything else that helps you know it's living

E- no

I- what if there was no chick in the egg

E- then it wouldn't be alive

I- so when is the egg living

E- ..if it has a chick

I- if there isn't a chick inside

E- it wouldn't be living

card # 15 (clouds)

I- is this a picture of a living thing

E- yes

I- how do you know

E- cause it pours rain

I- anything else that helps you to know the clouds are living

E- I don't know

card # 16 (jack-in-the-box)

I- is this a picture of a living thing

E- ..no

I- how do you know

E- because it doesn't move

I- it doesn't move at all

E- it pops up but it can't move from place to place unless a kid carries it

I- it does move but it's a different kind of movement

card # 17 (fire)

I- is this a picture of a living thing

E- I don't know

I- what do you think

E- not living

I- how do you know

E- ..I don't know

I- think about some of the things we talked about already you told me the jack-in-the-box wasn't living and now you're telling me the fire is not living do you remember why you said the jack-in-the-box wasn't living

E- because it doesn't move

I- could you say the same thing about fire

E- if it if it was alive and it was spreading it would be alive but not in a picture

I- let's pretend it was a real fire burning in the forest is it living or non-living

E- living because it can spread

card # 18 (jet)

I- is this a picture of a living thing

E- yes

I- how do you know

E- because it can move

I- does it do anything else to help you know it's living

E- it carries people

I- is the fish able to carry people

E- no

I- is the fish living

E- yes

I- so you think the jet is living

E- yes

card # 19 (seed)

I- is this a picture of a living thing

E- no

I- how do you know

E- because it doesn't move

I- anything else

E- it doesn't need to get fed

I- anything else you wanted to tell me about the seed

E- no

card # 20 (water)

I- is this a picture of a living thing

E- .uhm..no

I- how do you know

E- cause it doesn't need to get fed but it can move

I- since the water can move does that mean it is a living thing

E- no

definitions:

living - can move. They eat food and need drink.

non-living - can't move by self. It doesn't need food and drink.

Subject F

card # 1 (boy)

I- Is this a picture of a living thing?

F- Hmm. .Yeah

I- And how do you know?

F- Because it has legs

I- Does anything else tell you it's a living thing?

F- ... It's wearing clothes..uh..it has hands..uh. has eyes, mouth, runners, shadows.

I- Is the boy able to do things that help you know it's a

living thing?
F- uh ha..yes
I- like what?
F- like..growing
I- anything else
F- ...clothes, runners, face, ears, nose, mouth, hands, shirt, jeans, shadow, eyebrows, eyeshadow..
I- is there anything more you would like to tell me about the picture or are you finished
F- finished

card # 2 (cat)
I- is this a picture of a living thing
F- yes
I- how do you know
F- because I saw one and it has a tail, eyes, nose, mouth, ears, feet, skin, fur, shadows, tail
I- does the cat do anything to tell you know it's a living thing
F- uh ha.. meow
I- it's able to make a noise uhm does it do anything else
F- purr
I- that's another type of noise
F- that's all

card # 3 (bird)
I- is this a picture of a living thing
F- yes
I- and how do you know
F- it has wings, beak, eyes, nose, skin..tummy..wings..beak..eyes..toes
I- does it do anything to help you know it's living...what is the bird able to do
F- hum..quack
I- so like the cat it is able to make a noise o.k. can you tell me anything else about the bird
F- it flies... that's all

card # 4 (worm)
I- is this a picture of a living thing
F- yes
I- and how do you know that
F- because it's moving
I- alright..the worm moves does it do anything else
F- hum has skin
I- so things with skin are living
F- uh ha and it has sort of a tail, stomach
I- where is it's tail
F- I guess right here....hum.. nose, eyes, mouth.. what's that thing around there
I- hum that's how it's body is segmented
F- segmenting..something at the end of it's tail

I- o.k..is there anything more you can tell me about the worm
F- (deep breath) has pink skin
I- uh no
card # 5 (flower)
I- is this a picture of a living thing
F- yes
I- and how do you know that
F- it has a stem, leaves, a shadow.. petals inside the flower,
moves
I- the plant is able to move
F- uhm hum
I- how does it move
F- with the wind by the wind
I- oh by the wind o.k. is it able to move any other way
F- uhm...by rain..it grows
I- is there anything else that helps you know the plant is a
living thing
F- has a stem, has an inside
I- oh it has an inside what do you mean by that
F- that stuff right in there people water it
I- so what does it need
F- sun
I- o.k. the plant needs sun
F- rain
I- rain
F- water
I- what happens if it doesn't get those things
F- it dies
I- anything else about the plant
F- it has things that hold the leaves
I- what are those things
F- right there they go right across
I- I see
F- green..that's all

card # 6 (fish)

I- is this a picture of a living thing
F- yes
I- how do you know
F- cause I know it has a tail..
I- do all living things have tails
F- no
I- do you have a tail
F- no hum it has eyes and a mouth it lives underwater..has
fins has a mouth.. has skin it's green lives on water
I- does it do anything to help you know it's living
F- it swims, moves
I- it moves
F- it can go fishing..it shines
I- look at the real fish did you notice it's mouth what is
it doing
F- it moves

I- do you know why
F- because it's breathing
I- do you breathe
F- yes
I- is there anything else you can tell me about the fish
F- there's a little hole that it breathes through that's all

card # 7 (trees)

I- is this a picture of a living thing
F- yes
I- how do you know
F- it has wood, leaves, stems, branches, you water them, it needs rain to grow
I- you did mention that it grows doesn't it
F- uhm hum
I- does it need anything else that helps you know it's a living thing
F- sun. sometimes you hum chop trees down and..it has leaves.has something going through the middle
I- what goes through the middle
F- wood
I- oh the wood goes through the middle
F- it's got little lines. sometimes they uh have squirrel holes. sometimes you can chop them down for a Christmas tree..sometimes they poke you. you get slivers from them
I- if you chopped this tree down what would happen to it
F- fall
I- have you ever chopped a tree down and taken it home for Christmas
F- yes
I- what have you had to put it in
F- hum. just something like you put it together and it has a little hole in it and you put it in
I- and did you ever give the tree anything
F- uhm hum decorations
I- did you ever pour anything into the container that holds the tree up
F- no but we chopped a tree down for fire wood. that's what me and my Grandpa did me and my uncle did I mean
I- is there anything else that tells you the tree is a living thing
F- it has mud around it. the water the water goes up the wood so it can grow
I- how does the water go up
F- it goes in the ground and then goes right up..the mud holds the tree..that's all

card # 8 (mushroom)

I- is this a picture of a living thing
F- no
I- how do you know that
F- because you eat it

I- so you eat mushrooms and they are non-living What else tells you that it's non-living
F- .you put it in spaghetti
I- o.k.
F- put them in mushroom soup..you could aha...pick them off the ground
I- have you seen mushrooms on the ground
F- no
I- where have you seen mushrooms
F- nowhere
I- you've never seen them expect in spaghetti
F- yeah and on pizza and what else..you see them maybe on roads
I- on roads
F- maybe a-n-d y-o-u..cut them that's all

card # 9 (car)

I- is this a picture of a living thing
F- yes no
I- no how do you know that
F- because you drive it, it has wheels, lights, has a roof, has license, has seats in it, has an engine, trunks, doors, these things
I- bumpers
F- bumpers,hum..back lights, windows, gas things
I- is there anything about the car that helps you to know it is non-living remember what you told me about things that are living remember what you told me about the cat
F- uhm hum
I- is the car the same
F- no (sneeze) it has lights, tires, windows, doors, has a back light front light, engine, trunks, seats, bumpers
I- and are all those things objects which belong to things that are non-living
F- yes
I- is there anything else you wanted to tell me about the car
F- yeah you start them..that's all

card # 10 (rock)

I- is this a picture of a living thing
F- hum no
I- and how do you know
F- because you don't see them move, you can pick them off the ground, you can't pick a grown-up up off the ground, you could pick up a small rock, you can't pick up a big rock
I- how do you know it's non-living you mentioned that it can't move was there anything else that tells you that it's non-living
F- it's heavy...
I- anything else you can tell me
F- it's grey, shines..
I- does that help you to know it's non-living

F- uhm hum yes. hum it has grass around it, has mud around it..too heavy to lift up you can climb up a rock can't climb up a person and hum doesn't have eyes, nose, ears, mouth, hair and a body and clothes and feet doesn't have jeans, people don't live in the grass so it's not alive

card # 11 (TV)

I- is this a picture of a living thing

F- no

I- and how do you know that

F- because you watch it, has buttons, channels, it's made out of wood.has a screen, has a V.C.R. on it, has a plug..

I- anything else that tells you that it's non-living

F- has these things that make it stand..and it has these lines, it has a screen, doesn't have an eyes, nose or mouth, legs or jeans and clothes or a body

I- so if it doesn't have those things what will we say it is

F- not a living thing and it has a wire and a plug

card # 12 (sun)

I- is this a picture of a living thing

F- hum that's hard to tell

I- well just tell me what you think

F- I think yes

I- what makes you think yes

F- well it shines, it moves

I- anything else that tells you it's a living thing

F- uhm..aha..

I- does it do anything that some of the other living things do

F- yeah it makes things warm uhm..it's yellow it doesn't have skin it's in the sky..goes around the earth that's all

I- so you think the sun is

F- alive

card # 13 (top)

I- is this a picture of a living thing

F- no

I- how do you know

F- you play with it uhm it has a thing it doesn't have an eyes or nose or mouth, doesn't have hair people don't have stars

I- anything else

F- it spins around fast hum..has lines to make it go fast

I- that's what the picture shows you to demonstrate that it is moving

F- has that thing around it it doesn't have feet

card # 14 (egg)

I- is this a picture of a living thing

F- uhm yes

I- how do you know

F- because it has something inside
I- what might it have inside
F- bird you might eat that egg you..you could eat it
I- if you can eat it, is it a living thing
F- no
I- but if there's a bird inside
F- it is
I- oh so you mean it could be a living thing or it could be non-living
F- yeah
I- tell me when you think it's a living thing
F- uhm when it hatches breaks
I- when is it non-living
F- when the egg when the bird's out of it and uhm
I- is there another time when it's non-living
F- when you eat it
I- anything else you wanted to tell me about the egg
F- it shines, it's warm, it doesn't have ears, eyes, nose and mouth
I- how do you know an egg is warm
F- because I felt one before a-n-d let me think that's all

card # 15 (cloud)

I- is this a picture of a living thing
F- yes
I- how do you know
F- because it moves, sends rain down, moves
I- anything else that tells you that it's living
F- uhm..it's white and..sends water down
I- anything else you wanted to tell me about the clouds
F- no

card # 16 (jack-in-the-box)

I- is this a picture of a living thing
F- no
I- how do you know
F- a person can't fit in a box, it's a toy and it has these things a spring, and pops out of the box, has a lid
I- it has a face
F- it's still not alive
I- even though it has a face
F- yeah..nobody lives in a box, has a lid, has a flower on it and.. that's all

card # 17 (fire)

I- is this a picture of a living thing
F- nope
I- how do you know
F- because if you light somebody you could burn yourself, it has wood, has flames, has smoke coming out, has blue spots, yellow spots, red spots, orange
I- how do you know the fire is non-living

F- because first of all..you have to get wood, and then you might light it, and it doesn't have eyes, nose or mouth
I- anything else you wanted to tell me
F- has flames..crackles almost like a golf ball that's all

card # 18 (jet)

I- is this a picture of a living thing

F- no

I- how do you know

F- uhm you drive it, you go on a trip with it, it has wings, sometimes it has guns, sometimes it has flames coming out, doesn't have eyes, nose or mouth, or hair or ears doesn't have legs, has tires when it lands and..it doesn't have hands almost like hands it's almost like a hand here the wings

I- do the wings work the same way that your hands do

F- well almost, yeap, it keeps it balanced, has a resting room with windows uhm

I- anything else

F- has small wings, big wings, it goes up in the air that's all

card # 19 (seed)

I- is this a picture of a living thing

F- no

I- how do you know that

F- uhm you throw it in the garbage, you don't eat it..it's made out of wood, a little bit made out of wood, it grows

I- if it grows, is it a living thing or a non-living thing

F- not a living thing, well people grow

I- people grow, what do you think about that

F- but this doesn't grow and it doesn't have eyes, nose, mouth, hair, body and

I- but does it grow

F- no

I- it can't grow is that what you're tell me

F- and it has a thing around it and it has little holes, and you get it in something and that's all

card # 20 (water)

I- is this a picture of a living thing

F- uhm yes

I- water is a living thing

F- uhm I think no

I- what do you think is it living or non-living

F- hard to tell

I- well let's just talk about the water and then we'll try and decide what we think it is

F- well..uhm it's in the lake, you get it from maybe a well, you could uhm drink it, comes out of some sort of lake, you goes out of the tap, sometimes the thing gets plugged, sometimes it gets dirty

I- so thinking about all those things you told me, is water

a living thing or a non-living thing
F- it is
I- you think it is
F- yeah it moves anyway, makes waves
I- o.k. so you think the water is living because it moves anything else about the water
F- that's all

definitions:

living - has a heart, moves, lives, grows, has legs, has skin and a body. You don't cut it, sometimes you could. It has hands, has claws. They die, rolls, has eyes, nose and mouth, and opens it's mouth to breathe and talk. It has eyes so it can look where it's going and you could dance.

non-living - doesn't have a heart. It's a reptile. Some don't have legs. They're wild. Some don't have feet like a snake. They don't have eyes, nose and mouth.

Subject G

card # 1 (boy)

I- is this a picture of a living thing
G- yes
I- how do you know
G- because..it's moving well it's breathing and it's alive
I- o.k. so you're saying it can move and it breathes does anything else help you know the boy is alive
G- it..ah..it's breathing
I- anything else
G- I can't think of anything else

card # 2 (cat)

I- is this a picture of a living thing
G- yes
I- and how do you know
G- bec-a-u-s-e it's moving too
I- the cat is able to move
G- and it's a living creature and it's breathing and it can catch birds and stuff
I- so it breathes and why does it catch birds
G- I guess to just chase
I- just to chase them does the cat eat birds
G- don't know
I- you're not sure about that
G- no

I- is there anything else about the cat that helps you know it's a living thing
G- not really

card # 3 (bird)

I- is this a picture of a living thing

G- yes

I- how do you know

G- because it can fly and it can move and it can eat things

I- is there anything more you wanted to tell me about the bird

G- it's alive

card #4 (worm)

I- is this a picture of a living thing

G- yes

I- and how do you know

G- because it's moving and it's alive

I- it can move what else can the worm do to help you know it's alive

G- it can eat I don't know what they eat (laugh)

I- anything else about the worm

G- not really

card # 5 (flower)

I- Is this a picture of a living thing

G- yes

I- how do you know that

G- cause it's growing and..it drinks water

I- do you know how it drinks

G- you pour milk I mean water (laugh) into the..onto the flower

I- you pour water up here on the petals or where do you pour the water

G- you pour it on the leaves and on the top here

I- so you said the flower can grow and you said it needs water does anything else help you know it's a living thing

G- no no not really

card #6 (fish)

I- is this a picture of a living thing

G- yes

I- and how do you know

G- because it can swim and it can breathe and it's alive

I- anything else

G- no not really you know why I can think if it because it's moving and stuff like that

I- how does the fish breathe

G- it breathes it breathes it makes bubbles water goes in it's mouth and then it comes out again

I- when you breathe what do you take in

G- air

I- is the fish taking in air

G- no he's taking in water
I- so he breathes water
G- yes
I- and you said it comes out again where does it come out
G- it comes out the mouth again
I- is there anything else you wanted to tell me about the fish
G- no

card #7 (trees)

I- is this a picture of a living thing
G- yes
I- and how do you know
G- cause it it's like the flower cause it's growing and it needs water
I- anything else
G- not anything
I- where do you put the water
G- you put it underneath the branches and the tree grows bigger and stronger
I- how does the water get into the tree
G- through the root
I- oh through the root where are they
G- right here..at the bottom
I- are they in the tree or in the soil
G- it's..they're in the soil

card #8 (mushroom)

I- is this a picture of a living thing
G- yes
I- how do you know
G- well it's like the flower
I- a mushroom is like the flower
G- yes
I- what can you tell me about a mushroom how do you know it's living
G- because it's growing and it needs water too
I- have you ever seen a mushroom growing
G- yes we had we had poison poison in our backyard that were these
I- so you have seen mushrooms growing have you seen them anywhere else
G- no not really
I- but you think they are living things
G- yeah

card # 9 (car)

I- is this a picture of a living thing
G- no
I- how do you know
G- cause it's not moving well it can move but you have to start it up

I- is there anything else that helps you to know it is non-living
G- no

card # 10 (rock)

I- is this a picture of a living thing

G- no

I- how do you know

G- cause it's not moving

I- anything else

G- no that's all

card #11 (TV)

I- is this a picture of a living thing

G- no

I- how do you know

G- because it doesn't walk (laugh) and it doesn't breathe and that's all

card # 12 (sun)

I- is this a picture of a living thing

G- no..I don't think

I- are you not sure

G- not sure

I- well what's your idea about the sun

G- I don't think so

I- you think it's non-living

G- yes

I- and why do you have that idea

G- because it doesn't move or anything but it moves but it goes down slowly

I- it does move but is the sun like the fish or is it like you

G- no it's higher than a person or a fish

I- it's higher..does it need any of the things that you need

G- no not really

I- so do you think the sun is a living thing or a non-living thing

G- I'm not too sure..no cause it doesn't have eyes or anything like that it's not living

card # 13 (top)

I- is this a picture of a living thing

G- no

I- how do you know

G- it can move but it doesn't have eyes or nose or mouth and it can't breathe

I- is there anything else you wanted to tell me about the top

G- no

card # 14 (egg)

I- is this a picture of a living thing

G- yes

I- how do you know
G- cause inside there might be a a little chickie or something
I- what if there is no chick inside
G- then it's not living
I- what if it's an eating egg
G- then it's just an egg
I- would it be a living thing
G- a not alive thing
I- so when is the egg living
G- when it's a chick..a chick inside

card # 15 (clouds)

I- is this a picture of a living thing
G- uh no
I- how do you know that
G- it moves but it moves..clouds move but 'cept they don't have eyes or nose or mouth and they can't breathe
I- do you know what makes the clouds move
G- the rain or something I'm not sure what makes it move
I- maybe the rain
G- or the wind
I- you think the clouds are non-living
G- yes

card # 16 (jack-in-the-box)

I- is this a picture of a living thing
G- no
I- how do you know
G- be-c-a-u-s-e it's not breathing and it's not alive
I- it has a face
G- but it has a face but it's a toy
I- is there anything else that helps you know it's non-living
you said it wasn't breathing
G- and it doesn't have a heart
I- do you have a heart
G- yes because I'm a living thing and I can breathe

card # 17 (fire)

I- is this a picture of a living thing
G- uhm no
I- how do you know
G- it moves a bit but it doesn't have a face or eyes
I- anything else that helps you to know the fire is non-living
G- it doesn't have a heart and that's all

card # 18 (jet)

I- is this a picture of a living thing
G- no
I- how do you know
G- because it can move but it does it can't breathe and it's not alive

I- anything else that helps you know that
G- it doesn't have a face

card # 19 (seed)

I- is this a picture of a living thing

G- no

I- how do you know

G- because it's not moving unless somebody picks it up

I- is there anything else you wanted to tell me

G- it doesn't have a face and it can't breathe

card # 20 (water)

I- is this a picture of a living thing

G- no it's

I- how do you know

G- because it can move and it doesn't have a face and it can't breathe

definitions:

living - it means that it's alive and it walk and it can move. It can breathe. They have a heart.

non-living - they can't breathe and they don't have a heart and they can't move.

Subject H

card # 1 (boy)

I- is this a picture of a living thing

H- yes

I- how do you know

H- because I'm living and that's the same as me

I- are there things about you that help us to know you're living

H- yeah, I move, I can talk, I can see, I can eat and I can walk

I- anything else

H- no

card # 2 (cat)

I- is this a picture of a living thing

H- yes

I- how do you know

H- because it's living because it can move, it can talk sort of and it has ears to listen, and it can walk , and it can eat that's all

card # 3 (bird)

I- is this a picture of a living thing

H- yes
I- how do you know
H- cause it can fly, it can eat, it can see, it can walk, it can talk
I- instead of talking what do you usually say
H- it makes a noise that's all

card # 4 (worm)

I- is this a picture of a living thing
H- yes
I- how do you know
H- because it can move and.. it can eat it eats apples because they always eat my crabapples on my tree and that's all

card # 5 (flower)

I- is this a picture of a living thing
H- yes
I- how do you know that
H- because..it's not living when you take it out of the ground because it needs water from the ground or soil and it doesn't have any soil when it out of the ground
I- if it's in the ground what would we say about the flower
H- well.. it has all the stuff to make honey and that's about all cause it can't eat
I- do plants eat
H- no they drink..they drink soil, water
I- so they are still taking in food they just do it in a different way than you do is the plant a living thing
H- yes
I- is it ever non-living
H- yes
I- tell me about when it's a living thing
H- when it's..plants sometimes move
I- and you said it had to be somewhere to be living
H- in the ground cause the soil's in the ground and that's it's food
I- is there anything else you wanted to tell me about the flower
H- (shakes head)

card # 6 (fish)

I- is this a picture of a living thing
H- yes
I- how do you know
H- cause it has eyes it has a mouth and it can breathe underwater most animals can't breathe underwater but fish can and it can move, it can eat, it eats worms..no it eats..I don't know what it eats
I- do you remember yesterday we looked at the little mosquito larvae
H- yeah
I- I bet fish eat mosquito larvae and I think they also eat

the green algae in the water if it was a pet, what would it eat

H- fish food

I- is there anything else you wanted to tell me about the fish

H- no

card #7 (trees)

I- is this a picture of a living thing

H- yes

I- and how do you know

H- well it's not moving but it does eat it eats soil, drinks water, has to have sun, that's all

card # 8 (mushroom)

I- is this a picture of a living thing

H- yes

I- how do you know

H- well it's not moving either but you can eat it but it is living but it's not living when you take it out of the ground it can be big and it can be small

I- have you ever seen mushrooms in the ground

H- yes

I- where

H- in the forest or in St. Vital park, by a lake..or by a raft in the lake

card #9 (car)

I- is this a picture of a living thing

H- no

I- and how do you know that

H- well it can move but you have to have gas for it to move it has tires to make it move, doesn't have legs, doesn't have eyes cause you have to drive to make it move, doesn't have any body..that's all

card # 10 (rock)

I- is this a picture of a living thing

H- no

I- how do you know

H- cause it's not moving, doesn't have eyes, it can't hear, doesn't have a mouth..and you can pick it up and it not in the ground, it doesn't breathe..and that's all

card # 11 (TV)

I- is this a picture of a living thing

H- no

I- and how do you know that

H- you need to plug it in to make it work and you can't change the channels you have to use the channel

changer..and it doesn't have any eyes or mouth or it can't

hear you have to turn the sound up to make it hear that's all

card # 12 (sun)

I- is this a picture of a living thing

H- hum..I think so

I- tell me why you think it's a living thing

H- well.I don't know what it eats but it moves, it doesn't have eyes or mouth and it can't hear but I think it's a living thing

I- and your feeling about that is because it moves is there anything else about it that helps you to know it's a living thing

H- no

card # 13 (top)

I- is this a picture of a living thing

H- no

I- how do you know that

H- because it doesn't have eyes and it's a toy..toys are not living

I- anything else

H- it doesn't have a mouth, it can't hear or talk to you..and that's about all

card # 14 (egg)

I- is this a picture of a living thing

H- yes

I- how do you know that

H- because...cause chickens live in it when they're a baby

I- there could be a chicken in there

H- so when the chickens come out it's not living any more

I- first you told me the egg was living

H- when when the chicken was inside it

I- when the chicken comes out what would we say about the egg

H- the egg wouldn't be living any more

I- what would you say about an eating egg

H- living

I- anything else you wanted to tell me about the egg

card # 15 (clouds)

I- is this a picture of a living thing

H- no not living

I- how do you know

H- cause it doesn't move usually only if there is a tornado it moves, and it doesn't have eyes or nose or mouth, it can't talk to you or doesn't have ears to hear..that's all

card # 16 (jack-in-the-box)

I- is this a picture of a living thing

H- no (laugh)

I- how do you know

H- cause it's a jack-in-a-box and jack-in-a-box don't live
you have to turn you have to turn it and the jack-in-a-box
jumps out

I- it has a face and you were telling me before that

H- but it doesn't talk or it can't hear you, it can't smell

I- so even though it has a face it doesn't

H- it's a doll

I- anything else you wanted to tell me

H- no

card # 17 (fire)

I- is this a picture of a living thing

H- no

I- how do you know that

H- because it can't talk but you can hear it and it can burn
people but it can't burn can't burn..blocks of metal

card # 18 (jet)

I- is this a picture of a living thing

H- no but but the people inside it are living unless it
crashes

I- how do you know it is non-living

H- it can't see, it has to have windows to see and someone has
to drive it to make it go and if you don't drive it very well
it can crash

I- anything else

H- no

card # 19 (seed)

I- is this a picture of a living thing

H- yeap

I- how do you know

H- because it is a seed and it's living because it has food
from in the ground or from a tree a peach tree..that's all

card # 20 (water)

I- is this a picture of a living thing

H- no

I- how do you know that

H- because it's not living..and it doesn't have a mouth but
you can hear it cause when the water's running and you can
wash your hands and mouth with it

definitions:

living - where it can move. It can talk to you. And
it can walk. And it has to have ears some things
have to have ears like people have to have ears.
Living things need food, lots of things to drink if
they're sick, and they have to have milk to make
their bones grow.

non-living - it doesn't move. Doesn't have eyes.

Doesn't have a mouth. You can't hear it..can't
smell and it can't walk.

TRANSCRIPTION OF POST-INSTRUCTION INTERVIEWS

Subject A

card # 1 (boy)

I- is this a picture of a living thing

A- yeah

I- how do you know the boy is living

A- cause it he can move he can talk

I- what else can the boy do or what else does he need

A- he needs some milk and water

I- anything else you know about the boy

A- no

card # 2 (cat)

I- is this a picture of a living thing

A- yeah

I- how do you know the cat is living

A- cause he can move and he can uhum uhum drink and talk I
mean meow (laugh) but he can't talk

I- no that's his way of talking isn't it can he do anything
else

A- no

card # 3 (bird)

I- is this a picture of a living thing

A- yeah

I- and how do you know the bird is living

A- cause he can fly that's his move

I- that's right that's how he moves

A- and he can eat and he can drink and..

I- any other ideas

A- no

card # 4 (worm)

I- is this a picture of a living thing

A- yeah

I- how do you know

A- cause he can move and he can hum eat and he can grow and
he can drink

I- anything else

A- no

card # 5 (flower)

I- is this a picture of a living thing

A- yeah

I- and how do you know the flower is living

A- cause it can grow it can it needs water and it needs sun
I- what would happen if you picked the flower out of the garden
A- it won't be a living thing I think it would be a living thing
I- it would be
A- yeah
I- and what would happen to it if you didn't care for it after you picked it
A- hum it would be a non-living thing it wouldn't move or grow o-r.it wouldn't need warmness or it wouldn't need water
I- do you remember this
A- yeah
I- that flower has been picked
A- yeah
I- what would you say about it living, dead, or non-living
A- it's living
I- o.k. what would happen if we took it out of the water and didn't give it any water
A- it would die
I- it would die that's right like this flower
A- yeah pink is my favourite colour
I- it's not looking very good is it what's happening
A- the buds are closing up
I- so you say when the flower is in the water it's
A- uhum a living thing
I- o.k. and when it's not placed in water what happens to it
A- it droops
I- and then
A- it dies

card # 6 (fish)

I- is this a picture of a living thing
A- yeah
I- and how do you know
A- cause the fish can move and it can.grow and it can drink and eat
I- o.k. anything else about the fish
A- no

card # 7 (trees)

I- is this a picture of a living thing
A- yeah
I- how do you know the tree is living
A- cause it can hum grow it can grow and it can it needs water
I- anything else
A- and it needs warmth
I- oh it needs warmth warmth is important for growing things

card # 8 (mushroom)

I- is this a picture of a living thing
A- yeah
I- how do you know
A- cause it can grow
I- what else do you know about mushrooms
A- hum.
I- anything else
A- no
I- if it can grow what does it need to help it grow
A- warmth and water and I know something else ahum and when
you cut it down it's non-living
I- is it non-living or is it dead
A- it's living
I- o.k. it's still living but it will
A- die
I- it will die so when you cut it
A- it will die

card # 9 (car)

I- is this a picture of a living thing
A- no
I- how do you know
A- cause the cars can't eat the cars can't talk or they can't
well they need gas and they need oil
I- does that make them living things
A- no
I- does the car move
A- yeah but people have to make them move
I- oh like they can't move by themselves
A- no (laugh)

card # 10 (rock)

I- is this a picture of a living thing
A- no
I- how do you know
A- it can't move it can't talk it doesn't need warmth or it
doesn't need water or it doesn't need..
I- can you think of anything else
A- no

card # 11 (T.V.)

I- is this a picture of a living thing
A- no
I- how do you know the T.V. is non-living
A- cause it can't eat, drink or talk or it people at the T.V.
studio have to make it talk
I- o.k. anything else about the T.V.
A- no

card # 12 (sun)

I- is this a picture of a living thing
A- yeah

I- and how do you know the sun is living
A- cause it can make it and other things warm
I- o.k. anything else
A- it makes water hot
I- does it do all the things that other living things do
A- no it doesn't drink it doesn't talk or it doesn't need food
I- and you still think it's living because it gives warmth
A- yeah and warmth to itself because it it's warm all around it it's warm all around the sun

card # 13 (top)

I- is this a picture of a living thing
A- no
I- how do you know
A- cause it can't..cause it can't move cause people have to make it move
I- anything else
A- it can't eat, talk or drink it doesn't need food that's all I know about the top

card # 14 (egg)

I- is this a picture of a living thing
A- no
I- and how do you know
A- cause it can't move it doesn't need water or it doesn't need food or to sleep
I- anything else about the egg
A- no

card # 15 (clouds)

I_ is this a picture of a living thing
A- hum no
I- how do you know
A- hum cause it can't hum it doesn't need drink it doesn't need food or water or
I- anything else
A- no

card # 16 (jack-in-the-box)

I- is this a picture of a living thing
A- no (laugh)
I- how do you know
A- cause it can't grow talk hum it can move but people have to make it move by a little handle
I- o.k. anything else
A- no

card # 17 (fire)

I- is this a picture of a living thing
A- hum no
I- how do you know the fire is non-living

A- cause people have to make it
I- anything else
A- hum no

card # 18 (jet)

I- is this a picture of a living thing

A- no

I- how do you know

A- cause it can't..people have to make it move and it doesn't
need water and drink but it needs gas and oil like a car

I- is it living or non-living

A- non-living

card # 19 (seed)

I- is this a picture of a living thing

A- yeah

I- how do you know

A- cause it can it can't move it can't talk it doesn't need
water

I- it doesn't need water

A- hum it needs water

I- it does need water and then what happens to it

A- it grows

I- so is the seed a living thing or a non-living thing

A- living

I- it's a living thing even though it doesn't move

card # 20 (water)

I- is this a picture of a living thing

A- no

I- how do you know

A- it moves but it can't talk or it can't..

I- anything else

A- no

definitions:

living- it can move it can grow and it can talk some
things can talk. It needs water, milk and food.

non-living- it means it's dead. It doesn't move, grow
or talk. It doesn't need water or warmth or food. It was
never living.

once-living- it once was living and it once could grow
but it has died.

Subject B

card # 1 (boy)

I- is this a picture of a living thing

B- yeah

I- and how do you know

B- because it walks and grows and it will move

I- anything else you wanted to tell me about the boy

B- no

card # 2 (cat)

I- is this a picture of a living thing

B- yes

I- how do you know

B- cause cats do the same thing they move they take showers by licking them

I- o.k.

B- and they always want to drink milk and eat cat food that's all I'm going to say about the cat

card # 3 (bird)

I- is this a picture of a living thing

B- yeah because it flies and it eats bird seed

I- anything else

B- and it's a bird and I don't know what else birds do

I- you don't know anything else about birds

B- no

card # 4 (worm)

I- is this a picture of a living thing

B- yeah because it turns into am hum hum beetle

I- o.k. it can grow into a beetle does anything else about the worm help you to know it's living

B- hum no yes because it moves slowly

I- anything else

B- no

card # 5 (flower)

I- is this a picture of a living thing

B- hum yeah

I- and how do you know it's living

B- cause cause if you give it water it will grow

I- what would happen to the flower if you picked it

B- it will die

I- but what if you picked the flower and put it in water

B- it would grow

I- it would still grow

B- hum

I- when would it die

B- hum if you take it out of the water

I- o.k. what if I just picked a flower and didn't put it in any water

B- it would die and it would droop

card # 6 (fish)

I- is this a picture of a living thing

B- yes cause it swims by it's what are these

I- fins

B- yeah by it's fins

I- right what else helps you know the fish is living

B- it eats

I- does it do anything else

B- sleeps

I- I guess it has to rest

B- yeah so it can grow or else it would die if it didn't get any sleep

I- I guess resting is important for living things anything else about the fish

B- no I don't think so

card # 7 (trees)

I- is this a picture of a living thing

B- hum hum yeah it's aha but I don't know a thing about trees

I- you knew a lot about the flower

B- yeah I know but

I- how do you know the tree is living

B- cause you need to water it and it grows and that's all I know

I- anything else

B- no

card # 8 (mushroom)

I- is this a picture of a living thing

B- no

I- mushrooms are non-living

B- yeah

I- and how do you know it's non-living

B- hum cause cause cause you eat it but some are poison and you don't eat poison mushrooms

I- o.k.

B- hum where do you actually get poison mushrooms

I- well some of them grow in the forest or the bush

B- that's where you find them

I- but you wouldn't eat those ones the ones you buy at Safeway are not poison are they

B- no

I- where do you think those mushrooms came from the ones at Safeway

B- a garden

I- so if they came from a garden what must have happened to them

B- grew

I- they grew if they grew does that make them a living thing
or a non-living thing
B- a living if they don't grow
I- so what would we say about mushrooms then are they living
or non-living
B- non-living
I- are they ever living
B- no
I- no they are always non-living
B- yeah that's right
I- they are always non-living that's your idea
B- yeah

card # 9 (car)

I- is this a picture of a living thing
B- no
I- how do you know the car is non-living
B- cause it just aha takes people places but it's not a living
thing
I- o.k. can you tell me anything else about the car
B- cause it needs gas and no people need gas to fill up or
else I would be a car I would be dead if I be a car for a
little while

card # 10 (rock)

I- is this a picture of a living thing
B- no
I- how do you know
B- I don't know because it's hard and it doesn't move that's
what I think
I- anything else
B- no
I- does the rock need anything
B- hum no I don't know anything else about rocks

card # 11 (T.V.)

I- is this a picture of a living thing
B- no because it's a T.V. and you watch some ahum ahum shows
and you can change the channel and you can turn the T.V. off
and on press some buttons change channels and all that and you
have to set it up before you watch T.V. cause if you don't set
it up you can't watch anything
I- right is there anything about the T.V. that's the same as
living things
B- cause it doesn't move
I- o.k. anything else
B- no
I- does it need anything like you do
B- no I think we'll just keep going on

card # 12 (sun)

I- is this a picture of a living thing

B- no cause it's a sun and it heats up everything

I- so the sun is non-living

B- yeah

I- but you said it can heat up things

B- and it moves

I- is there anything else that helps you know it's non-living

B- no

I- does it need anything that you do

B- no I don't even think that

I- like it doesn't need to eat or drink like you do

B- no

I- so to you the sun is non-living

B- yeah

card # 13 (top)

I- is this a picture of a living thing

B- yeah

I- the spinning top is living

B- yeah no

I- is it living or non-living

B- non-living

I- how do you know

B- cause it just spins around

I- o.k. you can spin around

B- yeah see I'll show you

I- does that mean you're non-living

B- no

I- you move differently from the top don't you

B- yeah I know cause I just move like this I move up and backward and sideways and around

I- oh you can move in a lot of ways but can the top

B- no it can just move around

I- oh just around anything else about the top that helps you know it's non-living

B- no

card # 14 (egg)

I- is this a picture of a living thing

B- no

I- the egg is non-living

B- and I don't know anything about it

I- well what would make you have that idea that it's non-living

B- cause people eat it and it might turn into a chicken

I- if there was a chick inside would it be living or non-living

B- living

I- so the egg can be living and non-living

B- yeah

I- when you eat it it's non-living is that what you said

B- ahum
I- and when there's a chick inside what would we call the egg
B- a living thing
I- a living thing o.k.

card # 15 (cloud)

I- is this a picture of a living thing
B- no I don't know anything about it I don't know anything about it
I- well is it living or non-living
B- non-living
I- how come you have that idea
B- hum I forgot what clouds are for
I- think about what clouds can do and think about what you can do
B- I could ahum walk in the rain
I- can clouds do that
B- no they can make they put they drop rain
I- think about what you need to keep you living
B- water
I- do clouds need water
B- yeah they need water inside what happens if there is no water inside what do clouds have inside
I- they do have water droplets and when they get full of water droplets it rains so what are you going to say about clouds are they living or non-living
B- non-living I don't know anything else about clouds

card # 16 (jack-in-the-box)

I- is this a picture of a living thing
B- no because it pops in and pops out
I- so it's non-living it has a face
B- yeah I know
I- does a face make it a living thing
B- no
I- so some non-living things can have faces
B- (yawn) hum ahum yes

card # 17 (fire)

I- is this a picture of a living thing
B- no
I- the fire is non-living
B- yeah
I- and how do you know that
B- just because
I- think about what you told me about living things you told me lots of things about living things
B- like they ahum they need ahum they smoke
I- you mean fire smokes
B- yeah right I mean people smoke and you have to use a match to start up the fire
I- o.k. does that make the fire a living thing or a non-

living thing
B- non-living
I- non-living because you have to start it with a match
B- yeah
I- anything else that makes it non-living
B- no

card # 18 (jet)
I- is this a picture of a living thing
B- yes
I- the jet is living
B- no
I- it's non-living and how do you know it's non-living
B- cause it just flies
I- o.k. it flies or it can move
B- and I don't know anything else about it I don't know much about airplanes
I- does it need anything
B- gas
I- does it need anything that you need
B- like it needs water so you can clean it
I- o.k. water for cleaning
B- and I don't know anything else

card # 19 (seed)
I- is this a picture of a living thing
B- they grow and that's all I know
I- are they living things or non-living things
B- non-living
I- now you told me that seeds could grow does that make them living things or non-living things
B- living
I- it makes them living things and you say they are living because they can grow
B- yeah
I- what do seeds need to help them grow
B- water that's all I know about seeds
I- seeds can grow and seeds need water so you have changed your idea you used to think seeds were non-living things and now you think they are living things

card # 20 (water)
I- is this a picture if a living thing
B- non-living
I- how do you know
B- because the water just goes right through and down
I- what helps you know it's non-living
B- ahum just because I don't know I don't know anything about it

definitions:

living- they move they need drink they need sleep they have to eat.

non-living- they are up in heaven dead people are up in heaven doesn't need sleep doesn't need to eat.

once-living- they will never live again but they died and are up in heaven and will never live again.

Subject C

card # 1 (boy)

I- is this a picture of a living thing

C- yeah

I- how do you know

C- because

I- how do you know the boy is living

C- because it lives in a house and it's non-living and lives in a house

I- does it need anything to help it live

C- yeah food and and water and milk and juice

I- so living things live in a house and need food is there anything else about the boy that helps you know it's a living thing

C- aha no

card # 2 (cat)

I- is this a picture of a living thing

C- yes

I- how do you know the cat is living

C- because it because it's living in

I- does it do anything to help you know it's living

C- no it doesn't do anything it's just living and it goes somewhere and it goes in the house

I- how is it able to go somewhere

C- well it's got four feet

I- and it's able to

C- eat and drink

I- o.k. it's able to eat and drink and go places so all that helps you to know it's living

C- yup

card # 3 (bird)

I- is this a picture of a living thing

C- no

I- why is the bird non-living

C- because aha

I- you're telling me the bird is non-living

C- nope I'm telling that's not living
I- it's not living and why is it not living
C- because it's..hum
I- is it anything like the cat
C- ahum no
I- not at all do you have any ideas why the bird is not living
C- I don't have any ideas I just don't know why

card # 4 (worm)

I- is this a picture of a living thing
C- yeah
I- the worm is living and how do you know that
C- because it lives under water
I- does it do anything else to help you know it's living
C- nope..no

card # 5 (flower)

I- is this a picture of a living thing
C- yeap
I- the flower is living how do you know
C- because it needs water to grow
I- o.k. that makes it a living thing if the worm is living what does it need
C- it needs water
I- yes all living things need that is there anything else about the flower that helps you know it's living
C- no

card # 6 (fish)

I- is this a picture of a living thing
C- yes
I- the fish is living and how do you know that
C- because it goes under water
I- watch this fish does it do anything else that helps you know it's living
C- it needs food
I- what's it doing right now
C- it's swimming around
I- it's able to move and it's got food right on top of the water here just like you said
C- yeah yeah if you put food in the water this thing swims around you know what I think it's almost gone
I- well it's been eating that food is there anything else about the fish that helps you know it's a living thing
C- nope

card # 7 (tree)

I- is this a picture of a living thing
C- yeah
I- how do you know
C- it needs water too

I- oh so what else needs water
C- yeah lots of things need water
I- o.k. does the tree need anything else
C- nope
I- is there anything else that helps you know it's living
C- no

card # 8 (mushroom)

I- is this a picture of a living thing
C- no no
I- the mushroom is non-living
C- no
I- how do you know
C- because (sigh) I don't know anything about it
I- you're not sure if it's living or not
C- no
I- what makes you think it's non-living
C- because I just know not not living
I- does anything make you think it is a living thing
C- nope it just needs water to grow on a flower
I- so maybe the mushroom needs water to grow if it does need water and if it does grow does that need it's living or not living
C- not living
I- it's not living I never change my mind

card # 9 (car)

I- is this a picture of a living thing
C- yes it moves it moves
I- anything else that helps you know it's living
C- well it it's got a steering wheel and it's a car
I- and it's a living thing
C- yeah
I- you told me living things grow does the car grow
C- yeap nope
I- you told me living things need food does the car need food
C- nope but it needs gas and water
I- is the car living or non-living
C- non-living
I- non-living so you're going to change your mind

card # 10 (rock)

I- is this a picture of a living thing
C- aha nope
I- how do you know
C- because I don't have no choice
I- how do you know it's non-living
C- because it's hard
I- o.k. it's hard anything else that helps you know it's non-living
C- you're not supposed to throw it you can throw it
I- you can throw it

C- and it doesn't move
I- anything else about the rock
C- nope

card # 11 (T.V.)

I- is this a picture of a living thing
C- yeap
I- the T.V. is living
C- it's got electricity and it can really shock you it can shock you
I- it can shock you does that make it a living thing
C- yeah but it's still a T.V. it can live and it doesn't move
I- it doesn't move is the T.V. a living thing or a non-living thing
C- non-living
I- non-living
C- yeap
I- you told me it was living just a minute ago what are we going to say is it living or non-living
C- ah
I- were you going to change your mind
C- yeah
I- so what are you going to say
C- non-living
I- why is it non-living what can't it do
C- ahum it can't move
I- anything else about the T.V.
C- nope

card # 12 (sun)

I- is this a picture of a living thing
C- no
I- the sun is non-living and how do you know
C- I said nope non no non
I- is the sun living or non-living
C- living
I- you think the sun is a living thing and why do you think that
C- because..it's bright
I- o.k. anything else that helps you know it's living does it need anything
C- it's hot
I- does that make it a living thing
C- yeah
I- do you want to tell me anything else about the sun
C- nope

card # 13 (top)

I- is this a picture of a living thing
C- (sigh) yeap
I- the spinning top is living
C- yeap

I- how do you know
C- because..
I- does that top do anything to help you know it's living
C- it it goes around fast
I- o.k. does it do anything else
C- hum (sigh)
I- does it need anything
C- no

card # 14 (egg)

I- is this a picture of a living thing
C- yeap yeap
I- the egg is living and how do you know that
C- because it's like it's easy to crack and and all the stuff comes out
I- and because of that you think the egg is living
C- yeap

card # 15 (clouds)

I- is this a picture of a living thing
C- nope
I- the clouds are non-living
C- nope
I- how do you know that
C- because the they make rain
I- how do you know they are non-living how do you know they are not living like the fish
C- because..hum I don't know

card # 16 (jack-in-the-box)

I- is this a picture of a living thing
C- yes
I- how do you know
C- because it is a toy
I- toys are living things
C- yeah
I- are toys living or non-living
C- non-living
I- so is the jack-in-the-box living or non-living
C- non-living
I- so you've changed your mind on that why is it non-living
C- well (sigh)
I- does it need things that you do
C- no
I- what doesn't it need
C- aha
I- what does the fish need
C- food
I- does the jack-in-the-box need food
C- no
I- is the jack-in-the-box living or non-living
C- non-living

card # 17 (fire)

I- is this a picture of a living thing

C- yeah

I- the fire is living

C- yeah

I- how do you know

C- because it is in the fireplace

I- you mean it lives there

C- yeap

card # 18 (jet)

I- is this a picture of a living thing

C- yes

I- how do you know

C- cause it flies and it lands at the airport airport and and there's a door for all the people to come out

I- o.k. so that makes it a living thing because it flies and lands and has a door

C- yeah

card # 19 (seed)

I- is this a picture of a living thing

C- they're living non-living

I- which is it are they living or non-living

C- non-living

I- why do you think they are non-living

C- because they grow in the garden

I- if something grows is it living or non-living

C- non-living

I- anything else you wanted to tell me about the seeds

C- no

card # 20 (water)

I- is this a picture of a living thing

C- no

I- how do you know

C- well like it comes out in the tub just like and it's water

I- why is the water non-living

C- because because it's water and it comes down fast

I- is the water like the boy because you said they were both living

C- no yeap no

I- are they living

C- yeap

I- is the water living or non-living

C- non-living

definitions:

living- it walks, it can move, it can make a noise.

non-living- anything that is living.

once-living- it can move, now it's dead.

Subject D

card # 1 (boy)

I- is this a picture of a living thing

D- yes

I- how do you know

D- well cause it moves and it can talk

I- anything else that helps you know it's living

D- no

card # 2 (cat)

I- is this a picture of a living thing

D- yes

I- how do you know

D- well it's a cat and it can hum meow and it can move and it can move it's tail

I- anything else

D- no

I- does it need anything

D- it needs milk and some food

card # 3 (bird)

I- is this a picture of a living thing

D- yes

I- how do you know

D- ahum well it flies in the sky and it makes nests and that's all

card # 4 (worm)

I- is this a picture of a living thing

D- yeah

I- how do you know

D- well cause it moves a little around slowly and it eats and it drinks and that's it

card # 5 (flower)

I- is this a picture of a living thing

D- yes

I- how do you know

D- well cause it grows when people plant flower seeds it grows if you put water on it

I- if we were to pick it

D- it will die

I- is it still living if we take it out of the ground

D- yes

I- what will happen to it

D- it will die and droop and get brown

I- did you want to tell me anything else about the flower
D- no

card # 6 (fish)

I- is this a picture of a living thing

D- yes

I- how do you know

D- well cause it moves under water and can breathe underwater just like that fish over there and it talks a little like this fish talk and it eats and drinks

I- anything else

D- nope

card # 7 (trees)

I- is this a picture of a living thing

D- yes

I- how do you know

D- well cause ahum it's a tree and when people when Jesus plants trees it grows and people plant them

I- does the tree need anything

D- yes water and rain

I- anything else you wanted to tell me about trees

D- no

card # 8 (mushroom)

I- is this a picture of a living thing

D- yes

I- how do you know

D- well cause it grows and people pick them uh no

I- can people pick them

D- no

I- have you ever eaten a mushroom

D- yeah but I don't like them

I- how do you think they got to the store

D- people picked them

I- people did pick them what do you think happens when you pick the mushroom

D- ahum I don't know

I- if you didn't put it in water remember we didn't put our flower in water and it's still

D- it's still alive though

I- right what would happen if you picked a mushroom

D- it would still be alive

I- but what if you didn't put it in water

D- it would die

I- so are mushrooms living or non-living things

D- living

card # 9 (car)

I- is this a picture of a living thing

D- no

I- how do you know

D- cause it doesn't talk or move unless if it has a face
I- oh so living things need a face
D- yes
I- is there anything else about the car that helps you know
it's non-living
D- it doesn't need water or to eat and people have to drive
the car it can't move by it's self
I- anything else
D- nope

card # 10 (rock)

I- is this a picture of a living thing
D- ah let me see nope
I- how do you know
D- well it doesn't grow or anything and it doesn't move less
people pick it up
I- anything else
D- no

card # 11 (T.V.)

I- is this a picture of a living thing
D- no
I- you mean a T.V. is non-living
D- right
I- how do you know
D- well it can't move less people pick it up and make it move
and it can talk if people turn the channel
I- if it can talk does that make it living
D- no and it doesn't have a face less if people turn it on
then it would have a face
I- you might see a face on the screen

card # 12 (sun)

I- is this a picture of a living thing
D- yes
I_ the sun is living
D- yes
I- how do you know
D- well it shines on on hot days on stuff like that
I- what else do you know about living things
D- uhuh they grow
I- does the sun grow
D- no
I- what else do you know about living things
D- they move around
I- does the sun move around
D- yes sometimes
I- what else do you know about living things
D- uhuh I don't know
I- oh you know lots of things
D- I forget them all though
I- you told me that living things need to drink and eat

D- oh yeah
I- what about the sun
D- uhum it doesn't have to it has to drink but not eat
I- what do you think is the sun living or non-living
D- living
I- it is still a living thing to you
D- yeah

card # 13 (top)

I- is this a picture of a living thing
D- no it's a non-living thing
I- how do you know
D- well it doesn't move or talk and it well if people pick it up it can move but it's not a living thing still

card # 14 (egg)

I- is this a picture of a living thing
D- yes
I- how do you know it's living
D- well cause it well when ducks or something hatches then something be in there
I- what if there was nothing in there
D- it would be non-living
I- so you said the egg is living if something is inside and
D- non-living if there's nothing inside and if there was something inside it would move and it would be living
I- the egg can move remember when we were looking at the pictures of the duckling, when it's pecking with it's beak it does move the egg
D- yeah

card # 15 (clouds)

I- is this a picture of a living thing
D- yes
I- how do you know the clouds are living
D- well cause it it gives rain and stuff like that and it moves around just like the sun
I- o.k. does it do any of the other things living things do
D- ..
I- like I remember some of the things you told me about the fish for example
D- it moves and it drinks and eats
I- what about the clouds
D- clouds can drink but not eat
I- what else did you tell me about the fish do you remember
D- no
I- I remember you told me it can do one thing and that's breathe
D- breathe
I- can the clouds breathe
D- no
I- so what do you think are clouds living or non-living

D- yes it can breathe though but it can it's still a living thing
I- it's still a living thing
D- not a non-living thing
I- not non-living
D- it's living though but not living it's non-living it it didn't give rain and stuff like that
I- oh o.k. you've got a different idea here you're saying the clouds are non-living if they don't give rain
D- right
I- if it does give rain
D- it is living

card # 16 (jack-in-the-box)

I- is this a picture of a living thing
D- no
I- how do you know
D- well it doesn't move less if somebody turns the knob and then it pops out even if it has a face it doesn't mean it's living
I- anything else you wanted to tell me about the jack-in-the-box
D- no

card # 17 (fire)

I- is this a picture of a living thing
D- yes
I- how do you know
D- well cause it hum when people made the fire then they hum put a match and then it lights up
I- does the fire do things that you can do or need things that you need
D- well they need wood and paper
I- are you saying that's like the food
D- hum no I mean yes
I- I'm wondering why you think this is living
D- cause it well it needs paper if it wants to go and it needs paper if it wants to go
I- o.k. does it need anything else
D- no or a match
I- is there anything else about the fire that helps you know it's a living thing
D- no

card # 18 (jet)

I- is this a picture of a living thing
D- no
I- how do you know
D- well cause it doesn't move less if people want to go to anything then people move it
I- so it can't move by itself
D- no

I- anything else about the jet
D- no

card # 19 (seed)

I- is this a picture of a living thing

D- yes

I- how do you know

D- cause when you plant the seeds ahum it grows less if you give it water

I- the seeds need water

D- ah uhum

I- these seeds haven't had any water so are they growing yet

D- no

I- but if we did give them water

D- they would grow

I- did you want to tell me anything else about the seed

D- ahum nope

card # 20 (water)

I- is this a picture of a living thing

D- yes but not the tap

I- so the water is living

D- yes

I- how do you know

D- cause it gives people water and ahum you can drink from it but ocean water is salty and you don't drink from that water

I- no how do you know the water is living though

D- aha

I- how is it the same as the fish or how is it the same as you

D- I don't know

I- but you still believe it's a living thing

D- yes but not the tap is

definitions:

living- it's alive, it has to move and talk. Even if it has a face it doesn't mean it's living. Some living things have a face. They need food and water.

non-living- can't grow, can't move

once-living- first it was living and then it got dead.

Subject E

card # 1 (boy)

I- is this a picture of a living thing

E- ahum yes

I- how do you know

E- cause a boy cause boys live

I- is there anything the boy does that helps you know he is

living
E- stand
I- anything else
E- no
I- does he need anything to help him live
E- water and food
I- is there anything else you would like to tell me about the boy
E- no

card # 2 (cat)

I- is this a picture of a living thing
E- yes
I- how do you know the cat is living
E- cause I just know cause it's standing up like the boy
I- o.k. does it do anything else to help you know it's living
E- it needs water and it needs food cat food
I- right anything else you can think of
E- no
I- is it able to do anything that helps you know it's living
E- it sleeps
I- it needs to sleep anything else you would like to tell me
E- no

card # 3 (bird)

I- is this a picture of a living thing
E- aha yes
I- how do you know it's living
E- cause it's wings are out
I- anything else that helps you know it's living
E- it needs water
I- it needs water
E- it needs food it needs to sleep in the winter
I- it might are you thinking that maybe it hibernates if it hibernates does that mean it's dead
E- sleeping for the winter
I- yeah just resting right
E- cause it's too cold for them
I- it could be too cold
E- they might freeze their wings
I- they might so maybe they just have to sleep through the winter is there anything else you can tell me about the bird
E- no

card # 4 (worm)

I- is this a picture of a living thing
E-..yes
I- how do you know the worm is living
E- it needs water
I- o.k. it needs water
E- it needs food
I- it needs some kind of food do you know what kind of food

the worm would eat

E- leaves

I- maybe leaves where do you find worms

E- on trees

I- oh on trees yes you can I was thinking somewhere else do you know somewhere else you can find worms sometimes they can be in the soil or mud but you're right they can also be on trees is there anything the worm does that helps you know it's living

E- moves

I- it moves anything else

E- no

card # 5 (flower)

I- is this a picture of a living thing

E- yes

I- the flower is living how do you know

E- because

I- how do you know a plant is a living thing

E- because it grows

I- o.k. it grows what else do you know about plants

E- they need water

I- they need water what happens if you pick a flower is it still living

E- no

I- then what would you call it

E- non-living

I- would you call it non-living or dead

E- .non-living

I- anything else you wanted to tell me about the flower

E- no

card # 6 (fish)

I- is this a picture of a living thing

E- yes

I- how do you know the fish is living

E- cause it can swim

I- can it do anything else

E- eat fish food

I- ahum hum do you know what it's doing now as it's mouth is near the surface of the water

E- breathing

I- it's breathing so what do you know about living things

E- they breathe

I- do you know anything else about the fish

E- no

card # 7 (trees)

I- is this a picture of a living thing

E- yes

I- how do you know

E- cause it grows..it needs water
I- needs water any other ideas
E- no

card # 8 (mushroom)

I- is this a picture of a living thing
E- it almost looks like they're all living
I- (laugh) what did you think about the mushroom
E- yes
I- it's a living thing and how do you know a mushroom is living
E- you can eat it
I- you can eat it does anything else help you know it's living
E- it grows
I- have you seen mushrooms grow
E- my friend has some in her yard
I- oh she does so you've seen them then
E- they're poison
I- some can be
E- her yard her yard ahum has poison mushrooms in it
I- her mom or dad might have to put something on the grass to get rid of those mushrooms
E- they're behind the trees
I- oh are they mushrooms like moist shady places that's probably why they are behind the trees do you know anything else about mushrooms and why they are living things you said they grow and that you can eat some of them
E- they need food and they need water
I- o.k. anything else
E- no

card # 9 (car)

I- is this a picture of a living thing
E- no
I- how do you know
E- because because it doesn't have a face
I- anything else that helps you know it's non-living
E- it doesn't need food or water
I- doesn't need food or water anything else
E- it moves but it's still not living
I- o.k. it is able to move but you think it is still non-living
any other ideas
E- no

card # 10 (rock)

I- is this a picture of a living thing
E- no
I- and how do you know
E- it doesn't move
I- o.k. the rock doesn't move anything else about the rock

that helps you know it's non-living
E- ..doesn't need food or water
I- doesn't need food or water anything else
E- no

card # 11 (TV)
I- is this a picture of a living thing
E- no
I- how do you know
E- cause it doesn't move doesn't need water doesn't need food
doesn't move
I- it doesn't need any of those things does it so we would
say that the TV is
E- non-living

card # 12 (sun)
I- is this a picture of a living thing
E- yes
I- how do you know
E- because it shines on people
I- anything else that helps you know it's living
E- ..no

card # 13 (top)
I- is this a picture of a living thing
I- how do you know
E- cause it doesn't need food or water
I- it doesn't need food or water
E- ahum
I- anything else you wanted to tell me about the top
E- no

card # 14 (egg)
I- is this a picture of a living thing
E- yes
I- how do you know the egg is living
E- cause it cause it might have a chick in it
I- it might anything else that helps you know it's living
E- no
I- would it matter if there wasn't a chick in it would it
still be living
E- no
I- if it didn't have a chick in it what would we say about the
egg
E- non-living
I- you'd call it non-living anything else you wanted to tell
me about the egg
E- no

card # 15 (clouds)

I- is this a picture of a living thing
E- no
I- clouds are non-living how do you know
E- they don't need food
I- they don't need food anything else
E- they don't move
I- they don't move anything else you can tell me about the clouds
E- they don't shine if it isn't raining you can't see them they're just air
I- oh clouds are just air that's an interesting idea anything else
E- no

card # 16 (jack-in-the-box)

I- is this a picture of a living thing
E- no
I- how do you know
E- it doesn't need food it doesn't need water
I- o.k.
E- it doesn't move unless it gets carried
I- it can move in what way does it move what does it do when you push it down into the box
E- it makes a noise for a bit and then it pops up
I- o.k. so it pops up is that a kind of movement
E- ah ha
I- but is it the same kind of movement that you can do
E- no
I- I also noticed that it has a face does mean it is a living thing
E- no
I- so you're telling me that some non-living things can have faces
E- yes
I- do we have any of those things on the table
E- ah ha
I- show me
E- (picks up toy)
I- yes the little squeeze toy it's non-living and what else
E- (picks up puppet)
I- the puppet

card # 17 (fire)

I- is this a picture of a living thing
E- yes
I- how do you know the fire is living
E- it keeps people warm like the sun
I- o.k. anything else that helps you know it's living
E- ah..
I- you had an idea what were you going to say
E- it doesn't need food
I- no it doesn't

E- it doesn't need water
I- what do you think about that if it doesn't need food or water is it a living thing or a non-living thing
E- both
I- you think it could be both
E- yeah
I- o.k. and do you know why it can be both you told me the fire can keep people warm like the sun so if it does that is the fire living or non-living
E- living
I- but because it doesn't eat or drink what does that tell you
E- that it's non-living
I- so you're going to say that the fire is both
E- yes

card # 18 (jet)

I- is this a picture of a living thing
E- yes
I- how do you know
E- cause it carries people
I- anything else that helps you know it's living
E- ..no

card # 19 (seed)

I- is this a picture of a living thing
E- ahum yes
I- how do you know the seed is living
E- it could grow
I- alright does it need anything
E- no
I- you know seeds need something (laugh)
E- water water
I- water anything else you know about seeds you've changed your idea about seeds haven't you you used to think seeds were non-living but remember we sprouted seeds and what happened to them
E- they grew
I- they must be
E- living things

card # 20 (water)

I- is this a picture of a living thing
E- no
I- water is non-living and how do you know
E- .cause it doesn't need food or water
I- anything else
E- no

definitions:

living - a person. They need food. They need water. They can move. They breathe.

non-living - doesn't need food. Doesn't move. They

don't need water.

once-living - they died. Only living things can die.

Subject F

card # 1 (boy)

I- is this a picture of a living thing

F- yes

I- how do you know

F- has a face has eyes has skin has clothes even though some don't

I- some living things don't have clothes

F- yeah they have hands some don't

I- is there anything the boy is able to do that helps you know it's a living thing

F- move talk it has a shadow

I- does he need anything

F- eyes hands

I- what does he need to keep him alive

F- food water

I- do you want to tell me anything else about the boy

F- yeah he has a nose and a mouth that's all

card # 2 (cat)

I- is this a picture of a living thing

F- yeah

I- how do you know

F- has a shadow has legs has a nose makes a noise has ears skin eyes tail some of them has legs

I- how do you know the cat is living

F- he needs food and he needs a drink

I- anything else a doll could have legs right

F- ah ha

I- does that make it a living thing

F- no

I- so we need to think of the things that help us know it's living

F- has ears that's all

card # 3 (bird)

I- is this a picture of a living thing

F- yeah

I- how do you know

F- has hands it can fly it has a teeny weeny beak it has skin

I- how do you know the bird is living

F- moves makes a noise has to eat has to drink

I- did you say it's able to make a noise

F- yeah and it moves

card # 4 (worm)

I- is this a picture of a living thing

F- yeah

I- how do you know

F- it moves has a shadow..has parts has eyes nose and mouth needs food drink and

I- anything else you can think of

F- it makes noises

I- you think a worm is able to make noise

F- yeah when it moves

card # 5 (flower)

I- is this a picture of a living thing

F- yeah

I- how do you know

F- it grows needs water sun warmness food

I- what would happen if we picked that flower from the garden

F- it will die

I- did our carnation that we put in the water die

F- no

I- why didn't it die

F- cause we put it in water

I- so even if you pick it does that mean it's dead

F- no

I- what would happen if you didn't put it in water

F- it would die

I- it will die

F- and it will droop

I- it will droop first and then

F- it will die

card # 6 (fish)

I- is this a picture of a living thing

F- yeah

I- how do you know the fish is living

F- because it has a it breathes has eyes nose mouth moves breathes ah

I- what else is it able to do

F- swim breathe that's all

card # 7 (trees)

I- is this a picture of a living thing

F- yeah

I- how do you know

F- it grows has leaves needs sun warmness food mud to hold it

I- anything else

F- no

card # 8 (mushroom)

I- is this a picture of a living thing
F- no
I- how do you know the mushroom is non-living
F- cause you eat it ahum has ahum eight dots on it and one leg to hold it you plant it
I- you plant mushrooms
F- yeah and they grow
I- if they grow what might they be
F- non-living living living things
I- they might be living things
F- yeah
I- what do you think is the mushroom a living thing or a non-living thing
F- non-living
I- you still think it's non-living why do you think it's non-living
F- it has eight dots has one leg to hold it you eat it that's all
I- you believe it's non-living even if it can grow
F- yeah

card # 9 (car)

I- is this a picture of a living thing
F- no
I- how do you know the car is non-living
F- because you drive in it has some lights on the back and the front it has windows and doors
I- how do you know it's non-living
F- has an engine
I- what makes the car different from you
F- it doesn't have an eyes
I- it doesn't have any eyes
F- doesn't have any feet doesn't have a mouth it could make noises
I- uh ha
F- it non-living you drive in it
I- does it need anything
F- yeah gas cars need an engine doors that's all I can tell you about this

card # 10 (rock)

I- is this a picture of a living thing
F- nope
I- how do you know
F- cause it doesn't move it's heavy has mud around it doesn't have eyes or nose or mouth doesn't have hands feet
I- anything else
F- doesn't have a heart doesn't have ears doesn't have clothes doesn't have skin and it can't make a noise
I- it can't make a noise
F- yeap

card # 11 (TV)

I- is this a picture of a living thing
F- no
I- you watch it for a long time and it needs a plug it needs
a wire needs switches needs a screen needs.. it's made out
of wood has channels
I- does it need some of the things that you need
F- no it needs electricity
I- do you need electricity
F- no that's all I can think of

card # 12 (sun)

I- is this a picture of a living thing
F- no
I- how do you know the sun is non-living
F- it gives people warmness and it goes in the sky has
clouds around it goes around the earth
I- is the sun living or non-living
F- non-living it doesn't need food it doesn't need drink or
water
I- anything else about the sun
F- it shines that's all

card # 13 (top)

I- is this a picture of a living thing
F- no
I- how do you know
F- cause it spins around in one place you turn it even
though it moves
I- even though it moves
F- it doesn't need water doesn't need something to eat ahum
I- anything else about the top
F- doesn't have eyes nose or mouth it doesn't have two legs
doesn't have hands skin shoes doesn't have clothing

card # 14 (egg)

I- is this a picture of a living thing
F- maybe maybe it has something inside
I- so we're going to say maybe
F- yeah
I- tell me when the egg is living
F- when it has something inside it doesn't have eyes nose or
mouth
I- if there is nothing inside what will we say about the egg
F- it's non-living sometimes you can eat it and sometimes a
bird is inside
I- anything else
F- it doesn't have legs and that's all

card # 15 (clouds)

I- is this a picture of a living thing
F- nope
I- how do you know

F- it gives us rain
I- anything else
F- it has a big fluff and the thunder makes noises when it cracks together in a storm it doesn't have an eyes nose or mouth and
I- anything else
F- and it doesn't have legs doesn't have ears doesn't have hands doesn't have skin doesn't have shoes doesn't have clothing that's all

card # 16 (jack-in-the-box)

I- is this a picture of a living thing
F- no
I- how do you know
F- cause you play with it ahum it lives in a box you need to wind it it has a spring lives in the box
I- does it need anything
F- no it doesn't need anything has a lid people don't have lids and even though it's a clown
I- it has a face
F- yeah even though it has a face and hands and it's attached to a spring
I- if it has a face does that make it a living thing
F- no

card # 17 (fire)

I- is this a picture of a living thing
F- no
I- how do you know
F- because anyway it has flames and needs wood and you need a match it has smoke coming out of it has red yellow and blue and doesn't have eyes nose or mouth
I- anything else about the fire
F- doesn't have ears or nose or mouth doesn't have hands or feet that's all

card # 18 (jet)

I- is this a picture of a living thing
F- no
I- how do you know the jet is non-living
F- because you fly it it has wings people travel it has gas flies with wings people don't have paint on them but the plane do does
I- anything else
F- needs that thing that goes around to fly
I- what thing goes around
F- what's that thing called (whisper)
I- you mean the light at the airport
F- no you know that thing on the plane
I- oh down here
F- on the wing thing
I- that's part of the engine

F- has an engine
I- anything else you wanted to tell me about the jet
F- no

card # 19 (seed)

I- is this a picture of a living thing
F- yeah
I- how do you know
F- it makes another plant
I- o.k. and what are the seeds able to do
F- make another plant they can grow
I- they are able to grow
F- they need food you need to plant them ahum the seeds have cracks in them the need food that's all

card # 20 (water)

I- is this a picture of a living thing
F- yeah
I- how do you know
F- cause it gets dirty you drink it and and it gets dirty it has living things in it
I- it has living things in it like what
F- like whales
I- oh I see or like
F- sharks dolphins
I- so you think the water is living because it has living things in it
F- yeah

definitions:

living - it moves. Something that talks. Something that makes noise. Something that eats and drinks. Something that can walk and swim.

non-living - they don't move. They don't talk. They don't make sound. They don't eat. They don't grow. They don't have a heart.

once-living - that they were once living and now they are dead.

Subject G

card # 1 (boy)

I- is this a picture of a living thing
G- yes
I- how do you know
G- cause it can move it's alive it has a heart it needs food and water and that's all
I- that's all I can think of

card # 2 (cat)

I- is this a picture of a living thing

G- yes it is

I- how do you know

G- because it can move and it can walk it can make noise and it needs milk and cat food

I- anything else about the cat

G- it has a heart that's about it

card # 3 (bird)

I- is this a picture of a living thing

G- yes

I- how do you know the bird is living

G- cause it has a heart and it can move and did I say it had a heart

I- yes

G- it can breathe and it needs food and water or whatever it drinks I know what it eats

I- what does it eat

G- it eats worms (laughs) let me think that's it about this picture

card # 4 (worm)

I- is this a picture of a living thing

G- yes

I- how do you know

G- it can move it can breathe it can walk

I- does it walk

G- well I mean it squiggles

I- it can still move

G- yeah

I- it just moves differently then you do

G- yeah

I- anything else that helps you know it's living

G- it eats whatever it eats I'm not sure it can breathe it has a heart probably and it needs food and water that's all

card # 5 (flower)

I- is this a picture of a living thing

G- yeap

I- how do you know

G- it can grow if you feed it right

I- o.k.

G- it needs water and it could grow and that's all

I- is it living only when it's in the ground or also when you pick it

G- it it lives when it's in the ground and when you pick it if you put it in water

I- let's say we picked a flower and we didn't put it in water what would happen to it

G- it would die

card # 6 (fish)

I- is this a picture of a living thing
G- yes
I- how do you know the fish is living
G- because it's moving it has a face and it has a heart and it needs water and fish food
I- anything else about the fish
G- no

card # 7 (trees)

I- is this a picture of a living thing
G- yeah
I- how do you know
G- because it's growing and hum hum see here it needs water it can grow that's it for the trees

card # 8 (mushroom)

I- is this a picture of a living thing
G- yes
I- how do you know the mushroom is living
G- because because it's it needs water and it can grow that's about it

card # 9 (car)

I- is this a picture of a living thing
G- no
I- how do you know
G- it doesn't breathe it doesn't move oh yeah (laugh) it doesn't breathe it doesn't have a heart it's not a living thing
I- it does move though doesn't it
G- yes
I- does it move the same way you do or does it move differently
G- it moves differently because you have to drive in it to make it move
I- anything else
G- no

card # 10 (rock)

I- is this a picture of a living thing
G- no
I- how do you know
G- because it can't move that's for sure it can't move unless you throw it
I- alright so it depends on someone to move it doesn't it
G- yes and it can't breathe it doesn't have a heart it doesn't..it's not alive

card # 11 (TV)

I- is this a picture of a living thing
G- ah let me see no
I- you're saying the TV is non-living how do you know

G- because it doesn't move well it doesn't move unless you carry it
I- yes it would move if you carried it but would it move by itself
G- no it can't breathe it doesn't have a heart it doesn't grow

card # 12 (sun)

I- is this a picture of a living thing
G- ah hum no
I- you say no how do you know it's non-living
G- because well because it doesn't have a heart it's not alive it moves all around the earth we are moving right now but we can't feel it
I- that's right that's kind of hard to understand isn't it
G- (laugh) my cousin doesn't even know that cause she's little
I- yes well she has to be grown up like you to understand that idea
G- that's all
I- so you're telling me that the sun is non-living
G- yes

card # 13 (top)

I- is this a picture of a living thing
G- no
I- how do you know
G- because I'm not sure (laugh) I know cause it doesn't breathe (laugh) and it doesn't have a heart and that's all it can move unless you pick it up and spin it
I- but if you didn't spin it would it be able to move
G- no

card # 14 (egg)

I- is this a picture of a living thing
G- yes
I- how do you know
G- cause it has a chick inside it (laugh)
I- what if it didn't have a chick inside it
G- it wouldn't be living it would be non-living
I- it would be non-living
G- yes

card # 15 (clouds)

I- is this a picture of a living thing
G- no
I- how do you know
G- it can't move well it can move but it can't breathe and it doesn't have a heart that's all
I- does it need anything like you do
G- no it has it rain snow too that's it's food and water
I- so does that make it a living thing
G- no it's just like the tree or something well no it isn't

I- is it like the tree
G- (laugh) no
I- so are clouds living or non-living
G- non-living

card # 16 (jack-in-the-box)

I- is this a picture of a living thing
G- no
I- how do you know
G- it's like this puppet right here it's not alive
I- how do you know it's not alive
G- because it can't breathe it doesn't have a heart
I- it has a face
G- yeap
I- does that mean it's living
G- no some things have a face but they're not living like
this (holds up puppet) it's not living
I- and is that like the jack-in-the-box
G- yeap
I- anything else you wanted to tell me about the jack-in-the-
box
G- no

card # 17 (fire)

I- is this a picture of a living thing
G- no
I- how do you know
G- cause it can't breathe and it doesn't have a heart and it
doesn't have a face

card # 18 (jet)

I- is this a picture of a living thing
G- no
I- how do you know
G- if it was it would have people in it
I- if there's people inside is the plane living
G- (laugh) well the people are
I- the people are living but is the plane
G- no
I- how do you know the plane is non-living
G- it has a face right here this is the face it doesn't have
a heart but the people do it can't breathe it can't move
I- can it move
G- yes
I- how does the plane move
G- by itself
I- does it
G- yes it does well it has wheels
I- how does the car move
G- someone has to drive it oh yeah
I- how does the plane move
G- (laugh) someone has to drive it

I- who drives it
G- a person
I- the pilot
G- (laugh) I forgot it didn't move by itself
I- anything else about the plane
G- no

card # 19 (seed)

I- is this a picture of a living thing
G- yes
I- how do you know
G- they can grow they ahum that's all
I- do they need anything
G- yes they need water and light
I- anything else
G- no
I- do you think our seeds in the fridge grew
G- no
I- why not
G- it was too cold
I- so seeds need to be
G- warm
I- they need a little bit of warmth as well
G- my desk is warm
I- but it's not very light in there is it they would probably
do best at home in a bright place where they are warm
G- I'm going to take them home
I- did you have anything else to say about the seeds
G- no
I- that idea has changed
G- I thought this was a pit but it's not
I- well that's a funny kind of seed because what do we usually
do with that seed
G- throw it out
I- right we usually throw it in the garbage we don't usually
plant it
G- we don't we planted pits to make an apple tree we have an
apple tree in the front yard
I- and you planted it from a seed
G- no it was already there when we bought the house cause the
people that lived there before already had it
I- but it originally grew from
G- seed

card # 20 (water)

I- is this a picture of a living thing
G- no
I- how do you know
G- it can't breathe and what else it can't eat and drink and
it doesn't have a face

definitions:

living - something is moving and it's growing. It needs drink and water. It needs food. It has a heart.

non-living - all the things that I said about the living things and they can't do that. Some can move. Don't need water and food. Doesn't have a heart. They were never living.

once-living - once growing, once breathing. They still have a heart but it's not beating. They were living things that grew and stopped growing and died.

Subject H

card # 1 (boy)

I- is this a picture of a living thing

H- yes

I- how do you know

H- cause it's like me and I'm a living thing and a boy is just like me cause I'm a boy

I- how do you know that you are living

H- cause I move by myself and I can talk by my self and I can eat

I- anything else

H- and I die ahum that's all

card # 2 (cat)

I- is this a picture of a living thing

H- yes

I- how do you know

H- because it's a cat cats are living

I- how do you know that does it do anything or need anything to help you know it's living

H- yeah it needs food it needs to eat it needs to drink ahum it it can move by itself it can talk by itself that's all

card # 3 (bird)

I- is this a picture of a living thing

H- yes

I- how do you know

H- it moves it flies but other things don't fly like I can't fly only birds can fly

I- but you are all able to move

H- right

I- living things move in different ways how else do you know it's living

H- cause it can eat and it can move by itself that's all

card # 4 (worm)

I- is this a picture of a living thing
H- yes
I- how do you know the worm is living
H- cause it moves it talks (laugh) it doesn't talk
I- are all living things able to make noise
H- no..like
I- do you know anything else about the worm that helps you know it's living
H- like snakes can't talk
I- ahum hum and are they living
H- yes

card # 5 (flower)

I- is this a picture of a living thing
H- yes
I- how do you know
H- because it has soil in the ground and it has it needs sun and it needs water but it isn't living when you take it out of the ground and don't put it in water and don't give it food
I- o.k. what happens to it then
H- it dies
I- what happens if you do take it out of the ground and put it in a vase with water
H- it will still live but it might die
I- it might if you just keep it in water it's not getting the same kind of food it gets from the soil so it could eventually die now if you care for the plant what is it able to do
H- it can grow
I- yes that's an important thing about living things

card # 6 (fish)

I- is this a picture of a living thing
H- yes
I- how do you know
H- because it breathes underwater but most animals don't breathe underwater I mean most people don't breathe underwater like I can only breathe underwater for only five seconds
I- you can't really breathe in the water can you you just hold your breath do all living things breathe
H- ahum yes
I- you think so
H- and all living things have a heart I mean..not
I- could we say that all living things have a heart
H- no
I- what could we say
H- some living things have a heart
I- can you think of something that's living that doesn't have a heart
H- a snake
I- you think a snake doesn't have a heart is there anything on the table here that's living that doesn't have a heart
H- yeah

I- what
H- the seeds
I- anything else
H- the..fish
I- you think the fish doesn't have a heart
H- yes
I- is there anything else you wanted to tell me about the fish
H- no

card # 7 (trees)

I- is this a picture of a living thing
H- yes
I- how do you know
H- because it grows in the ground it's like a Christmas tree
the one in the middle ahum it has lots of sun but sometimes
you have to cut trees off to give it sun cause other trees are
are over it and it doesn't give them sun
I- ah ha that's true what's happening to the trees outside
now
H- they're they're all their leaves are falling off
I- o.k. and does that mean they are living or non-living
H- they are still living
I- they are still living but what are they doing right now
H- the leaves are falling off
I- are they doing much growing right now
H- no
I- no they're probably just resting
H- but they're still living

card # 8 (mushroom)

I- is this a picture of a living thing
H- yes
I- how do you know
H- because a mushroom's living but sometimes it isn't living
when you pull it out of the ground it isn't living and you can
eat it but I don't like mushrooms
I- does the mushroom stop being a living thing
H- when you pull it out of the ground and it doesn't have soil
or water
I- then what happens to it
H- it dies and you can eat it that's all

card # 9 (car)

I- is this a picture of a living thing
H- no
I- how do you know
H- because you need to fill it up with gas to make it move
I- does anything else make it move
H- yes the steering wheel I mean the tires ahum
I- how does the car move differently from you
H- you need to make it move but you can move without someone
helping you to move

I- alright so living things are able to move by
H- themselves
I- but non-living things
H- can't move by themselves
I- so there is a different kind of movement
H- yes
I- anything else that helps you know the car is non-living
H- no

card # 10 (rock)

I- is this a picture of a living thing
H- no
I- how do you know
H- cause you can just pick it up and throw it it isn't in the
ground it doesn't need water or anything it's non-living

card # 11 (TV)

I- is this a picture of a living thing
H- no
I- how do you know
H- you need to plug it in to make it go on and it it needs
cable to make it go on
I- does it need anything like you do
H- no
I- no
H- but some parts of it is living
I- which parts
H- around here cause if it was.it's wood
I- so why do you think the wooden part is living
H- once it was living because it comes from a tree
I- sure you could certainly say that

card # 12 (sun)

I- is this a picture of a living thing
H- no
I- how do you know the sun is non-living
H- because if it needs sun it couldn't get sun because it was
the sun (laugh)
I- anything else that helps you know it's non-living
H- if it needed water it couldn't have water because the water
is under it the water couldn't go up it goes down
I- alright so what are you going to tell me the sun is living
or non-living
H- non-living

card # 13 (top)

I- is this a picture of a living thing
H- no
I- how do you know

H- it doesn't move you make it move like the car you have to

make it move
I- anything else about the top

card # 14 (egg)

I- is this a picture of a living thing

H- once it was living

I- o.k. and when was it living

H- like the egg here isn't living any more because it doesn't have a chicken inside any more but this egg might be living because you never know if it has a chicken inside or not

I- so what do you want to call it living or non-living or how
H- dead

I- you'd like to call it dead

card # 15 (clouds)

I- is this a picture of a living thing

H- no

I- how do you know

H- cause it doesn't have any food

I- it doesn't have any food

H- it doesn't need any food

I- do you know anything else

H- it moves by itself but it's not living

I- anything else

H- no

card # 16 (jack-in-the-box)

I- is this a picture of a living thing

H- no

I- how do you know

H- cause it doesn't move you have to make it move and you have to wind it up to make it jump out of the box

I- alright

H- it has a face but it doesn't have any heart or it doesn't need food or it doesn't need to drink and it's non-living

card # 17 (fire)

I- is this a picture of a living thing

H- .one part is

I- which part is living

H- right here (points to the wood) but the fire isn't living

I- o.k.

H- only the tree part is living

I- would that wood still be living

H- it's burnt

I- so we would have to call that

H- dead

I- dead or something that was once living anything else you wanted to tell me

H- nope

card # 18 (jet)

I- is this a picture of a living thing
H- nope it was like the car you need to make it move it needs gas and you need to make it stop you can make yourself stop you can hear it but it can't talk or it doesn't have a mouth
I- anything else
H- no

card # 19 (seed)

I- is this a picture of a living thing
H- yes
I- how do you know
H- cause it was from a peach a seed is living like these seeds so all seeds are living
I- how do you know these are living
H- cause they grow into things
I- they grow into things sure remember when we planted the bingo chips what happened to them
H- they didn't grow
I- how come
H- cause they don't need water they don't grow
I- are they living things
H- no
I- anything else you wanted to tell me about the seeds
H- no

card # 20 (water)

I- is this a picture of a living thing
H- no
I- how do you know
H- because it doesn't need food if it needed water where would it get the water it's the water
I- o.k.
H- and it couldn't get food because it doesn't have a mouth
I- so you're going to say it's
H- non-living

definitions:

living - they can move by themselves. They can eat. They can talk. They can walk by themselves. And they need to eat or they will starve and they will die. They can grow.

non-living - they don't eat. They can't talk by themselves. They can't walk by themselves. They don't need to drink.

once-living - used to be living but they died.

APPENDIX B

REQUEST LETTER AND PERMISSION LETTER

27 Packard Place
W i n n i p e g ,
Manitoba
R2N 2M9

October 12, 1989

Deputy Superintendent
School Division

Dear _____,

I am currently studying in the Faculty of Education at the University of Manitoba, where I am completing my Master of Education, Department of Educational Psychology. I am working on my thesis research and would very much like to conduct my study in your school division.

The purpose of my study is twofold; firstly, to identify the alternate conceptions used by children ages five and six as they reason about living and non-living organisms; and secondly, to promote conceptual change through the development and implementation of an instructional sequence.

I am hoping to work with the Kindergarten and Grade One teacher at _____ School. Since I am familiar with both of these early years programs, I should be able to conduct research in an unobtrusive manner. The teachers have no specific responsibilities in relation to the study; only an understanding that no formal science teaching on the topic of living and non-living objects is to occur prior to the intervention.

The nature of the intervention is as follows; four children will be randomly selected from each of the two identified classes to participate in the study. Initially there will be a period of exploratory play where children have the opportunity to manipulate objects and informally discuss their existing ideas about living and non-living organisms. In order to ascertain each child's beliefs, individual interviews, using an open ended questioning technique, will be conducted. These interviews will be audiotaped. At the completion of the interviews, children will have an opportunity to discuss their ideas with their peers and "test out" these ideas on the objects provided. Children will then participate in a variety of science activities designed to challenge their existing ideas about living and non-living organisms. Children's handling of objects and participation in the various science activities will be videotaped for later analysis. Both audiotapes and videotapes will be destroyed following the thesis defense. Finally, individual interviews

will be conducted to determine if elaboration and/or modification of original ideas has occurred. The estimated length of contact time with each child is 2 1/2 hours.

I would like to emphasize that complete discretion and confidentiality is guaranteed regarding the school and the children. Children have the right to withdraw at any time from the study if they so desire. Names will not be presented in the final thesis publication. All results will be made available to the division. Further, there will be no costs involved for the school or the teachers participating in the study. If any materials required are not available in the schools they will be provided by the researcher.

I sincerely hope that your School Division will consider allowing me to conduct my thesis study at _____ School. I am very willing to meet with you or other persons involved to explain the study in more detail. Your consideration of this request is greatly appreciated and I look forward to your reply.

Sincerely,

Leslie Wurtak
phone: 256-9278

October 16, 1989

Leslie Wurtak
27 Packard Place
Winnipeg, Manitoba
R2N 2M9

Dear Leslie:

Re: Research Project

Thank you for your letter outlining plans for your thesis research and your request to conduct the study at _____ School.

I assume you have made contact with Mrs. _____ to discuss the details of your project with her. Your research looks very interesting and I would support your efforts subject to appropriate arrangements and approval being made at School. I advise you to contact _____ to discuss the details further.

Please accept my best wishes for a successful completion of your program.

Yours truly,

Deputy Superintendent

November 3, 1989

Dear Parent,

This letter is a request for permission to involve your child in an educational research project as part of my requirements for completing a Master of Education degree at the University of Manitoba.

The research project I am undertaking focuses on children's ideas about certain science concepts and how these ideas develop. The purpose of the project is twofold; firstly to identify children's ideas about living and non-living objects and secondly, to help children accept new and more scientifically accurate ideas about living and non-living objects. This project has been discussed with and approved by staff of the school and school division.

The children have been randomly selected from Kindergarten and Grade One classes. Children in the study will be informed of their involvement in the project. They will have the opportunity to handle objects and discuss their ideas about living and non-living. In order to find out each child's ideas about living and non-living, individual interviews will be conducted. Following the interviews, the children will share their ideas with other children in the project. Children will then participate in a variety of science activities designed to challenge their ideas about living and non-living objects. At the conclusion of the project, individual interviews will be conducted to determine if children's original ideas about living and non-living objects have changed. To ensure accurate recording of the children's ideas, the individual interviews and group discussions will be audiotaped and their participation in the science activities videotaped. Both the audiotapes and videotapes will be destroyed after the data has been analyzed.

The project will be conducted during the month of November, 1989. Children will participate in four short sessions for a total of approximately 2 1/2 hours.

I would like to emphasize that complete confidentiality and privacy is assured regarding the children. Children will have the right to withdraw from the study at any time if they so desire. If you would like to receive a copy of the summarized results, I would be pleased to send you a set.

If you approve of your child's participation in this project, please complete the section below with your name and signature, and return in the stamped, self-addressed envelope.

Should you have any questions regarding this study, please feel free to contact me at 256-9278.

Your consideration of this request is greatly appreciated.

Sincerely,

Leslie Wurtak

I, _____, consent to the inclusion of my child in the research project entitled "Children's Conceptions of Living and Non-living Objects".

I would like to receive a copy of the summarized results. yes _____ no _____

Parent's Signature

Date