COMMUNITY BASED SCIENCE EDUCATION FOR FOURTH TO SIXTH GRADERS: INFLUENCES OF A FEMALE ROLE MODEL

by

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COMMUNITY BASED SCIENCE EDUCATION FOR FOURTH TO SIXTH GRADERS: INFLUENCE OF A FEMALE ROLE MODEL

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Women in the United States are underrepresented in science related careers. The *Wonderwise* curriculum was designed to encourage young women to become more involved in science and science careers. The *Wonderwise* kits have won numerous awards for quality science curriculum for formal educational environments. In 2000 the kits were adapted and new kits were developed to meet the needs of a nonformal learning environment (i.e., 4-H). The kits contain a video field trip with a featured female scientist demonstrating her work, an activity guidebook with five activities based on this scientist's work, and a CD-Rom serving as an additional resource.

This study contributes to our understanding of a group of 4-H youth who used the Wonderwise curriculum. It describes their view on science, their perspective about people who do science, the importance of role models within their lives, and their career visions.

This study was a multi-method case study design. The subjects were youth ages 9 –11 involved in 4-H events in a three state area. Events such as overnight camps, day camps, special events and after school programs featuring the *Wonderwise* curriculum were used as sites for this study. The subjects studied in the

Wonderwise 4-H project were primarily female youth who had some interest in science. Nearly half were Caucasian; the remainder were Hispanic, African American and Native American. The 25 youth involved in this study took part in a semi-structure interview process including four research methodologies: open-ended questions, drawing or writing a story about the featured scientist, a card sort activity and a relationship map drawn by the youth.

Youths' prior experiences in formal, informal and nonformal settings impacted how they made sense of and incorporated *Wonderwise* experiences in their frame of reference. Through the experiential learning process youth experienced science activities and connected to individuals with science backgrounds, particularly those individuals within their relationship network such family members, and teachers who "do" science. Girls within this study related to and identified with the female role models presented in the *Wonderwise* 4-H curriculum. Native American youth related to a Native American scientist based on a similarity in culture.

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This was a huge undertaking for a first research project. This project taught me the importance of role models within my life. The individuals involved with this evaluation team believe in experiential learning and the impact of role models. I was allowed to take the time I needed to understand all the research concepts and methodologies I was experimenting with. I had support from this group and a depth of knowledge and experience base to fall back on for support. This project would not have been possible without my co-researchers: Dr. Judy Diamond, Saundra Frerichs, Dr. Kay Rockwell, and Dr. Amy Spiegel.

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Chapter I

Introduction

It is a brisk morning. Youth from various 4-H clubs clamor out the door of an old brick building into the courtyard area. Their chatter fills the air. The children carry with them equipment needed for the next event. Individuals walking in the courtyard stop to watch as the children cluster in small groups throughout the courtyard area. Team discussions begin concerning the breakdown of tasks. Children stretch out transect lines and gather magnifying glasses and data recording sheets. Exclamations of new findings fill the air as children, on hands and knees, diligently search each area for signs of living organisms. Adults move from group to group, listening and facilitating discussion about plants and insects, answering questions and offering words of encouragement.

These children are participating in the Cool Tools activity and taking on the role of an ecologist much like Carmen Cid, the urban ecologist featured in the video they just viewed. This activity is just one which can be found in the *Wonderwise* 4-H curriculum. The activities are written to encourage youth's work through inquiry-based activities to heighten interest in science and scientists.

Research indicates that children need hands on experiential activities to gain science skills, and to create interest in science and scientific careers. Nonformal educational settings, such as 4-H, have the potential to offer children a different kind of classroom. Gurian (2001) credits any environment a child is in as a learning environment. Diamond (1999) places emphasis on the benefits of inquiry based learning in nonformal settings. She describes nonformal learning as an intensely social experience which occurs within the context of family or peers. This learning is built on prior knowledge characterized by unconscious imitation which results in new learning. A large part of nonformal learning involves play and requires different thought processes than formal learning. Understanding these thought processes and learning connections could open the door to better understanding children's learning. This study opens a window into this understanding.

Cultivating Scientific Interest in Youth, Particularly Girls

Women in the United States, as well as certain minorities, are proportionately underrepresented in most scientific and technological disciplines (Lee, 1998; AAUW, 1992; NSF, 1999; Oakes, 1990). Despite recent advances, females continue to be underrepresented in the sciences, and their attrition rates are higher than those of men (National Science Foundation, 1982). Disparities, such as lack of role models, are often said to result from background factors that put children at a disadvantage in quantitative disciplines (Hardin & Dede, 1973; Koch, 1992; Sloat, 1992; Lee, 1998). Accumulating research suggests that girls' disadvantages may lie in the way educators cultivate interest, rather than how they ration or restrict opportunities to learn (Fennema, 1984; Fox, 1980; Oakes, 1990; Reyes, 1980; Wilson & Boldizar, 1990; Lee, 1998).

To address the needs and encourage women to become more involved in scientific careers, a multi-media program, *Wonderwise*, was developed. The *Wonderwise* curriculum is a series of kits developed through a partnership between University of Nebraska State Museum and Nebraska Educational Television. Initial development began in 1992. Original kits contained a 10 to 15 minute video, consumable materials needed to complete five curriculum activities, an activity guide, and a bibliography of the featured scientist. The kits used real women scientists as potential role models and provided inquiry-based curriculum activities modeled on the actual work of these living scientists. *Wonderwise* was originally designed for formal education in elementary classrooms to supplement science curricula in grades four through six. *Wonderwise* emphasizes the learning of science through identification and experience. Identification happens with women scientists by closely following their lives and activities. Science experiences are developed by engaging children in related inquiry-orientated activities (Speigel, Diamond, Dethlefs, n.d).

Previous studies of *Wonderwise* curricula have established its effectiveness in formal elementary classroom settings. Based on the findings of a pilot study, Spiegel, Dethlefs and Diamond (1997) found that using the *Wonderwise* curriculum had a positive impact on children's view of scientists and science. These results suggested that *Wonderwise* kits might indeed impact children's thinking about scientists and science.

Expanding Wonderwise to Nonformal Youth Education

Because science education lends itself to out-of-school experiential experiences at camps, museums and after school programs, there was an opportunity to expand *Wonderwise*'s utilization base. Cooperative Extension's 4-H youth program has a long history of success in educating youth through nonformal educational processes. The development of a partnership between the 4-H program and a nationally recognized science curriculum (i.e., *Wonderwise*) seems to enhance the opportunities for youth in rural and urban areas. It exposes youth to science through a unique delivery system.

Therefore, 4-H programs in land grant universities were chosen as the test site for expanding *Wonderwise* use as a nonformal youth educational experience. The 4-H youth program uses the knowledge of the land-grant university system to help youth reach their full potential through developing life skills and learning by doing. In 4-H, youth have fun, meet new people, learn new skills, build self confidence, learn responsibility, and set and achieve goals (National 4-H, 2002). As the largest youth organization in the United States, 4-H builds its programs on local clubs, fairs and shows, camps, state 4-H youth gatherings, special events, national 4-H congress, national 4-H conferences, international 4-H youth exchanges, school enrichment and collegiate 4-H (National 4-H, 2002).

Following the development and distribution of the original *Wonderwise* kits, the University of Nebraska State Museum (UNSM) in partnership with the youth development section (i.e., 4-H) of the University of Nebraska Cooperative Extension Division sought funding to develop the *Wonderwise* 4-H Project. The National Science Foundation (NSF) funded the *Wonderwise* project to develop three additional kits and to reformat original kits for use in the nonformal educational setting of 4-H.

The goals of using *Wonderwise* in the 4-H program are to:

1. Motivate eight to twelve year old youth, particularly girls, to pursue an interest in science and an awareness of scientific activities and careers.
2. Create a positive image of women and minority scientists for youth participating in 4-H.

3. Improve diversity and quality of 4-H's out-of-school science materials by offering materials that are inquiry-based, multicultural and that tie science activities to the work of real scientists.
4. Help youth connect agricultural topics and their underlying scientific principles.
5. Install in youth a better appreciation of empirically-based knowledge and enhance children's ability to use scientific reasoning (Diamond & Heusel, 2000).

Integration of the 4-H *Wonderwise* kits into the 4-H science curriculum was tested in 10 states: Nebraska, Minnesota, Wyoming, Oklahoma, Michigan, Montana, Illinois, Iowa, North Dakota and South Dakota.

The Comprehensive Evaluation of Wonderwise 4-H

An evaluation team representing the NSF grant, the UNSM, and the 4-H youth development program implemented a comprehensive evaluation plan. It called for four evaluation processes:

1. <u>End of session questionnaires for feedback on training activities.</u> Adult 4-H staff were oriented to the *Wonderwise* curriculum and its use in a specially designed training series. Upon completion of each training series, end-of-session questionnaires assessed the ability of the 4-H staff to use the *Wonderwise* curriculum. Additionally, questions were asked which defined trainees' ability to train other adults in their statewide 4-H program.

2. A web survey to adults who used the *Wonderwise* curriculum. A web site survey gathered information about the usage of the *Wonderwise* 4-H curriculum. Questions were designed to find out what worked about the curriculum and the problems experienced by users of the curriculum.
3. Personal interviews with state contact personnel. Each state contact person in the 10-state pilot project was personally interviewed to gather information on their state's use of (a) training opportunities, (b) scheduled programming, and (c) dissemination of *Wonderwise* kits. The interviews helped establish sites for researching how youth synthesized the subject matter in a nonformal setting.
4. Research on how youth synthesize the subject matter in nonformal educational settings. Interviews, field notes and documentation of children's work was gathered at six research sites across the 10-state area. This research emphasis is the foundation upon which the study reported in this dissertation was built.

Study of Youth Synthesizing Wonderwise Content in Nonformal Setting

The Study Purpose

The purpose of this research was to (a) explore how children participating in an experiential learning module (i.e., *Wonderwise* 4-H curriculum) in nonformal educational settings connect to science and a scientist role model and (b) to better understand if children incorporated the subject matter into their thinking.

Research Questions

The grand tour question was: How does the use of *Wonderwise* 4-H kits in a nonformal educational setting affect the ways children think about science and scientists?

Specific sub questions include:

1. In what manner did individual children identify with the role models in the *Wonderwise* 4-H kits?
2. How did children use the activities and videos in *Wonderwise* 4-H as they incorporated subject matter into their thinking?
3. What patterns emerged as the children incorporated the subject matter from the 4-H *Wonderwise* kits into their current knowledge?

Significance of the Study

This research describes how children responded to one experiential learning process in a nonformal setting (i.e., 4-H). The research contributes to the evaluation of the experiential process to increase children's awareness and interest in scientific topics and careers. The perceptions of individual children about the context of this curriculum and its impact on their thinking, creative work, and future plans, offers a glimpse into their thoughts and learning about science. Based on this research, decisions can be made about (a) using experiential learning processes for science education in nonformal educational settings, (b) how to improve and use 4-H *Wonderwise* kits in additional nonformal youth education settings to encourage children to interact with science and science related materials and topics, and (c) the importance of scientific role models in the lives of pre-adolescents.

The *Wonderwise* curriculum has been studied within formal classroom settings. The transition to nonformal educational settings presents new opportunities to look at its impact, beyond how it is used in a formal classroom context. The nonformal educational setting allows for immersion by the researcher into the child's experience and offers opportunities for rich qualitative study based on observation of a program in action.

Definition of Terms

Evaluation Team - Representatives from NSF, UNSM, and the 4-H youth development program who planned and implemented multiple methods to evaluate *Wonderwise* 4-H.

Formal Education - Education usually associated with schools. The hierarchy of a structured, chronologically graded educational system running from primary school through university and including, in addition to general studies, a variety of specialized programs and institutions for full-time technical and professional teachers (Coombs, 1973).

4-H Program - The youth education branch of the Cooperative Extension Service program of the United States Department of Agriculture. Each state and each county has access to a County Extension office for both youth and adult programs (National 4-H, 2002).

4-H Youth - Members of the 4-H program ranging in age from five to twenty-one years (National 4-H, 2002).

4-H Adult Leaders - Volunteers or paid Extension staff who have been trained to work with youth enrolled in 4-H.

4-H Teen Leaders - Youth specifically trained to use leadership skills in 4-H projects that include working with younger 4-H youth. Teen leaders must be at least 14 years of age.

4-H Camps - Refers to those 4-H camps taking place over several days and include a sleep away from the home component.

4-H Day Camps - Refers to those 4-H camp activities taking place during the daytime hours and do not include a sleep away from the home component. Day camps are either a series of days or one day events.

4-H Clubs - A group of youth ages 5 to 21 who meet as an organized entity enrolled in and using 4-H curricula. These clubs may be organized around a topic such as livestock, or by age with members enrolling in a variety of topic areas. Each club usually has a name, adult leaders and an organizational structure.

4-H Special Event **-** A one-time event organized around a central theme or activity. These events are sponsored by 4-H and are open to all youth, not just 4-H members. These special events are usually coordinated and led by 4-H adult leaders or Cooperative Extension staff.

4**-H School Enrichment Programs -** 4-H curricula designed to complement and expand elementary school curriculum. In some activities, such as Water Festivals, teachers plan educational activities before and after a day field trip where the children experience activities that teach them about waters' role in ecology. In other activities, such as *Wonderwise* Cooperative Extension staff may facilitate activities in an existing before/after school program.

4-H Experiential Model - A design by Pfeiffer and Jones (1981) which includes several stages within the model including the experience, time to communicate and share observations, process time to allow for analyzation and reflection, generalization which allows for relating the experience or activity to the real world, and application which allows for use of what was learned in a similar situation (Carlson & Maxa, 1998). Kolb (1984) notes that knowledge results from the interaction between theory and experience (Figure 1.1).

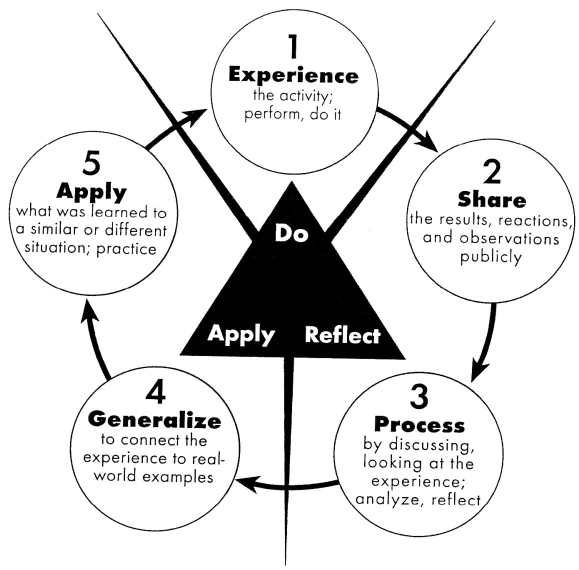

Figure 1.1. 4-H Experiential Model

Identification - The steps by which the ego grows in ever more mature interplay with the available models. The fate of childhood identification in turn depends on the child's satisfactory interaction with trustworthy representatives of a meaningful hierarchy of roles (Erikson, 1968). Josselson (1996) says that idealization and identification are ways of linking to powerful others and striving to become like them.

Informal Education - Education that is voluntary and self-directed, life long, and motivated mainly by intrinsic interests, curiosity exploration, manipulation, fantasy, task completion, and social interaction. Informal learning can be linear or nonlinear and often is self-paced and visual or object-orientated. It provides an experiential base and motivation for further activity and learning. The outcome of an informal learning experience in science, mathematics, and technology, includes better understanding of concepts, topics, processes, and thinking in scientific and technical disciplines, as well as increased knowledge about career opportunities in these fields (National Science Foundation, 1982).

Nonformal Education - Any intentional and systematic educational enterprise; usually outside of traditional schooling; in which content is adapted to the unique needs of the students, or unique situations used to maximize learning and minimize other elements which often occupy formal school teachers (i.e., taking roll, enforcing discipline, writing reports, etc.) (Kleis,1973; Etling, 1993).

PIAT - The acronym used by the researchers for the final activity within each *Wonderwise* curriculum kit. This document called Pulling It All Together (PIAT) is a synthesis activity asking the youth to create a story about the kind of scientist just featured within the *Wonderwise* kit (See Appendix A).

Relationship Map - The name given to the final activity of the research interview process. Based on the work of Ruthellen Josselson (1996), the map is drawn by the individual being interviewed and included depictions of individuals important in their lives (See Appendix B).

Triangulation - Triangulation of information in qualitative research is the convergence of sources of information, views of investigators, different theories, and different methodologies, which represents the triangulation of ideas which help support the development of central themes (Denzin, 1970). In case study research, Stake (1995) places emphasis on sources of data and suggests that the researcher triangulate differently based on "data situations" in the case (Creswell, 1998).

***Wonderwise* -** An inquiry based science curriculum developed for children age 8 to 12 by the University of Nebraska State Museum. Women scientists and their work are featured in video, CD formats and supplemental activity oriented materials which expand the video presentation so youth can experience activities related to the woman scientist.

Assumptions

It is not the intent of this study to generalize information gathered to the population at large. Rather, the intent is to understand how participants using *Wonderwise* kits in nonformal 4-H settings are impacted in their thinking about science and scientists through the videos and associated activities. The purpose of a case study is not to represent the world, but to represent the case (Denzin & Lincoln, 1994). A case study can usually be seen as a small step toward generalization, but generalization should not be emphasized in all research (Feagin, Orum, & Sjoberg, 1991; Simmons, 1980; Denzin & Lincoln 1994).

Limitations

Ethical considerations. It was projected to have a mix of ethnicities with a concentration of individuals representing minority population. However, the sites in the Midwest offered only limited access, or skewed access, to minority populations. Additionally, language and cultural barriers were present when individual children had limited knowledge of English since the *Wonderwise* curriculum used in this research was in English only.

Generalization to all nonformal youth programs is not possible. This study is limited to youth who participated in *Wonderwise* 4-H projects, camps and special events.

Institutional review board implications. The Institutional Review Board (IRB) required that identity of the individual youth be protected. Children had to be referred to by an ID number rather than name or initials. The IRB limited the kinds of demographic information gathered from the youth to gender, age and ethnicity. Addresses and contact information could not be gathered. These limitations impacted the manner in which researchers could document validity from interview transcriptions, because member checks were not an option. In addition, longitudinal study follow-up in six weeks or six months to explore longer-term impact was not an option (Appendix C).

Youth age. Youth ages 8 to 12 can be difficult to interview. On some sites youth had very little time to get acquainted with the interviewers prior to the interview. Some children had limited patience with adult strangers asking multiple questions, especially when other youth were off doing something far more exciting such as swimming, playing ball or having free time.

The interview environment. Interviews needed to take place in a variety of settings with multiple distractions. Additionally, some interviews needed to take place at the end of a long day. In some cases, the two interviewers completed an interview with youth who were tired and had a short attention span; this may have limited their thinking power. Interviews needed to be informal, yet they needed to be structured sufficiently to gather the needed data.

Chapter II

Literature Review

Introduction

Studying the effectiveness of a curriculum is often a difficult and challenging task. Understanding how specific materials are impacting children's thinking and their learning can be difficult at best. It is important to look at impact and current perceptions youth have in their thought processes when trying to know how children think about science. Questions are raised about what causes women to not choose science careers. What do girls say about science? How are female experiences in a formal setting different than that of their male peers? What do nonformal or informal settings look like for girls? Why choose these settings to study science learning?

Usually, children are tested in formal settings to measure what they have learned. Formal education generally takes place in a classroom within a standard school setting. Science is part of the regular curriculum, with everyone participating in the same lesson with the same expected outcomes. Measurement of learning becomes a matter of comparing test scores. This is not an option in a nonformal educational setting. This type of setting provide an individual with diverse and open-ended experiences. Assessment of learning in this format is a challenge. Formulating and understanding how learning takes place through experiences in this type of environment requires an understanding of experiential learning models.

The *Wonderwise* curriculum has been studied within formal classroom settings. The transition to a nonformal setting presents new opportunities to look at its impact beyond how it is used in a classroom context. This type of setting allows for immersion by the researcher into the child's experience and offers opportunities for rich qualitative study based on observation of a program in action.

To better understand these questions in a nonformal educational setting for youth, several topics were explored in the literature. They are:

1. The history of the *Wonderwise* curriculum.
2. Woman's perception of science and scientific careers.
3. Significance of adult role models.

History of the *Wonderwise* Curriculum

The original *Wonderwise* science curriculum kits were a joint venture in 1992 by Dr. Judy Diamond, University of Nebraska State Museum (UNSM) and Nebraska Educational Television (NET). The original proposal was funded through grant dollars from the Howard Hughes Medical Institute. The *Wonderwise* project was designed as a series of museum outreach kits. The purpose was to motivate young girls to pursue scientific activities and careers. The *Wonderwise* project required establishing partnerships with educational institutions across Nebraska, evaluating teachers' uses of museum based science kits in formal classrooms, and creating multimedia kit materials.

Partnering with Educational Institutions

In 1991, preparing for the *Wonderwise* project, museum staff contacted educators across Nebraska to see if partnerships could be established. Nebraska has more small school districts than any other state; these districts are organized into 19 regional units called Educational Service Units (ESUs). Most school districts are served by one of the 19 ESUs. All 19 ESUs agreed to become partners in the *Wonderwise* project.

The other significant partnership was established with Nebraska State Department of Education. The state department agreed to undertake a portion of statewide dissemination of *Wonderwise* kits. The department allocated federal Eisenhower funds toward teacher support, training workshops, and follow-up.

Formative Evaluation

The next step was learning the needs and constraints faced by Nebraska educators. Through extensive surveys, the museum staff learned what kinds of kits Nebraska teachers wanted and how *Wonderwise* project should organize activities to meet teachers needs (Diamond, Hochman, Gardner, Schenker, & Langan, 1996).

Selecting topics. Staff surveyed Nebraska teachers to learn what kits would be most useful. The survey sampled 183 K-8 teachers from rural and urban areas of Nebraska during November of 1992. Teachers surveyed showed interest in insects, geography, dinosaurs, rocks and minerals, Indian artifacts and Nebraska fossil animals (Diamond et al., 1996).

Learning about kit use. Next came a series of three surveys examining how Nebraska teachers use science kits within their classrooms. The survey results helped to shape the content and format of the *Wonderwise* kits (Figure 2.1).

Survey Results	***Implications for the Wonderwise Format***
Over two-thirds of the survey respondents spend 30 to 60 minutes per day on science. Twenty-one percent spend less than 30 minutes per day.	Each *Wonderwise* kit contains five activities organized into 50-minute blocks, with a maximum amount of flexibility in the sequence of use.
Over 80 percent of teachers with previous museum-kit experience use them to supplement, but not to replace, the existing curriculum. The kits are used most often for science classes, but over half of the teachers also use them for social studies, writing, and art.	*Wonderwise* activities are designed to be used in science, math, social studies, and art classes. Biographies are included for their use in reading classes.
Most teachers who have used museum kits utilize them in teacher-directed activities. Less than half use them in student-directed activities. However, The Nebraska State Department of Education supports multi-grade classrooms and encourages student-directed activities, recognizing the variety of developmental levels of students.	*Wonderwise* activities are student-centered, using teachers as resource and guide.
Teachers prefer small-sized kits that can be distributed by mail or their ESU and easily stored in the classrooms.	*Wonderwise* kits fit in a cardboard box (10” x 13” x 4”) that is easily sent through the mail or stored in the classroom.
Between $20 and $100 was an acceptable cost for purchasing a kit (within that range, the amount varied regionally). Most teachers said they would purchase kits if they cost $50 or less. About a third of 4th -grade teachers have between $10 and $50 in annual discretionary funds to buy science materials for their classroom, about one-quarter have between $50 and $100.	The *Wonderwise* kits are loaned to teachers at no cost from their local ESU. On loan from the museum, the kits are available for $10 per week to cover the shipping and replacement costs. They will also be available for purchase by a publisher.
Classrooms in Nebraska vary enormously in their available technology, but all teachers have access to a VCR. Teachers welcomed video as long as it was used with, rather than replacing, participatory activities.	The videotapes and the CD-ROMs in the *Wonderwise* project were designed with maximal flexibility so that kit use is not dependent on the availability of the appropriate technology.
Three-quarters of the 4th-grade teachers surveyed were interested in incorporating the museum’s science kits into their district wide curricula. In Nebraska, each school district is responsible for deciding its own curriculum.	The museum works with individual school districts, the ESUs, and the Nebraska Department of Education to help schools incorporate *Wonderwise* into ongoing curricula.

Figure 2.1. Results of Formative Evaluation on Science Kit Usage (Diamond, et al., 1996)

Further evaluation of teacher needs. A video conference in June of 1993 further assessed the needs of rural and urban elementary teachers in Nebraska. Teachers emphasized that distinction between rural and urban was less important than access to training and innovative science materials. Not all rural schools were "resource poor". Some rural schools had access to local science and math learning centers. Others had poor access to any science materials.

Teachers in urban areas seemed eager to have access to innovative materials focusing on science. Teachers in rural areas were more concerned about access to science materials first. Emphasis on innovative science was secondary (Diamond, et al., 1996).

Kit Development

The five original *Wonderwise* kits were designed to provide young elementary age students with real female scientists as role models. Each kit featured a different woman scientist and portrayed her life through three different media. A videotape of the scientist was created showing different aspects of the scientist's life. Five inquiry based science activities were designed to allow children to experiment with science concepts introduced by the kit. A written biography of each scientist was also included in the original kits. Each of the original kits contained a CD-ROM and materials to complete the activities.

The development team. Each aspect of the kit was developed by experienced professionals willing to coordinate their work with those of other professionals working on different kit elements. Collaboration took place between UNSM, NET, NET's interactive-media group, a professional science writer, a children's science activity writer, a production researcher, and elementary teachers (Diamond, et al., 1996).

Scientists selection. The selection of five female scientists whose work would make up the kit's contents was key to the future successes of the project. Scientists were sought who displayed the following criteria:

1. Individuals who had earned a doctorate and were well respected by peers in their field of expertise.
2. Individuals with diverse ethnic backgrounds willing to commit time to this project.
3. Research topics which lent themselves to video portrayal.
4. Individuals who were conducting research during the project time line.
5. Individuals whose research would be relevant to grades 4 through 6 classroom curricula (Diamond, et al., 1996).

Video production. The *Wonderwise* videos were designed to serve as "taped field trips" for students, especially those in remote rural areas who rarely have access to scientists in a school setting. Each video features the scientist's unique style and personality along with their research. The cameras allow children the opportunity to view actual research in action.

Activity books. The curriculum development of each activity book included five 50 - to 60 - minute classroom activities related to the featured scientist's research. Staff were guided by several national efforts in science curriculum reform including the work of the National Research Council on reforming science (1990, 1996), the Project 2061 report on biological and health (Clark, 1989) and the Kellogg

Foundation's report on science curricula (Kellogg Foundation, 1993). While the kits were being developed, the State of Nebraska Department of Education initiated Mathematics and Science Frameworks (Nebraska State Board of Education, 1994). Therefore, *Wonderwise* activities were linked with the Nebraska science standards (Appendix D). For the 2000 NSF grant, *Wonderwise* focused on National Science Education Standards (Appendix E) to set the following goals:

1. Orchestrate discourse among students about scientific ideas.
2. Challenge students to accept and share responsibility for their own learning.
3. Recognize and respond to student diversity and encourage all students to participate fully in science learning.
4. Encourage and model the skills of scientific inquiry, curiosity and openness to new ideas and data, and skepticism that characterizes science.
5. Use multiple methods and systematically gather data about student understanding and ability.
6. Create a setting for student work that is flexible and supportive of science inquiry.
7. Display and demand respect for the diverse ideas, skills, and experiences of all students.
8. Encourage collaboration.
9. Structure and facilitate ongoing informal discussion based on a shared understanding of the rules of scientific discourse.

10. Model and emphasize the skills, attitudes and value of scientific inquiry (Diamond & Heusel, 2000).

Guideposts provided by the state and national science standard initiatives included:

1. Participants and inquiry based science activity which encouraged creative constructivist processes.
2. Mathematics integrated into pertinent activities.
3. Student-centered activities allowed for varying abilities of students.
4. Placed teachers in the role of guide and support versus leader (Diamond, et al., 1996).

Prior to release, trial testing was also completed in select classrooms across the state.

Biographies. Each kit contained a biography on life and work of the featured scientist. The *Wonderwise* Biographies were written for an upper elementary audience (Diamond, et al.,1996).

CD ROM. CD ROMs were produced for three of the five original kits. The CD ROMs were designed to be flexible, interactive resource guides. The purpose was to provide additional resource information about the featured research topic and scientist. Each CD ROM was dual formatted for either Macintosh or IBM-compatible computers (Diamond, et al., 1996).

Kit topics. Topics for the first five kits were:

1. *Sea Otter Biologist* featuring Brenda Ballachey, Ph.D., who studies the impact environmental disasters have on ecosystems.
2. *Pollen Detective* features Margaret Bollick, Ph.D., who studies the role pollen plays in our lives, including the effect it has on allergies.

3. *Rainforest Ecologist* features Janalee Caldwell Ph.D., as she gathers scientific data, monitors frogs and insect population, and explores the ecology of the rainforest.
4. *Parasite Sleuth* features Judy Sakanari, Ph.D., as she conducts experiments on worms inside fish during her research of the cycles of living things.
5. *African Plant Explorer* features Fatimah Jackson, Ph.D., who explores the interaction of food, energy, and personal health through her study of African plants.

In 1997 a fifth kit was developed, *Urban Ecologist,* featuring CarmenCid, Ph.D, who explores the diverse life in a pond ecosystem. Additionally the *Wonderwise* web site was revamped and expanded which made it possible to download the activities free over the internet.

Summative Evaluation

A variety of methods have been used to evaluate the original *Wonderwise* curriculum series (Appendix F). During initial development stages, Nebraska elementary teachers filled out a needs assessment about kit contents and availability of science supplies used to complete the activities. Prior to release, trial testing was also completed in selected classrooms across the state. Research included (a) demographics on classroom useage, (b) classroom observation and informal student interviews were conducted, (c) surveys of teachers and students were conducted, and (d) finally a comparative evaluation has been completed between classrooms using *Wonderwise* kits and classrooms using other NSF funded science curricula.

Initial evaluation by Spiegel, Dethlefs, & Pytik (1997) interviewed mentor teachers across the state of Nebraska after training and classroom use of each kit. The focus of the interview was on one kit and its components, video, biography and activities. Teachers commented on the versatility of the kits as stand-alone units or as supplemental materials to existing curricula. The most important thing teachers felt their students gained from these kits were exposure to actual scientists who were "real people". Teachers also commented on student's greater awareness of environmental issues, scientific processes and increased content knowledge.

Early evaluations by Spiegel, et al. (n.d.) have assessed three criteria in students' views on their perceptions of scientific activities, their attitudes about science, and their perceptions of scientists. A comparison study between classrooms using *Wonderwise* curriculum and classrooms using other inquiry-based science activities found students in classrooms using *Wonderwise* (a) named significantly more activities scientists do than students in comparison groups, (b) saw science as an important school subject, and (c) included personal descriptors, including a name, when asked to describe a scientist.

Finally, a web-based survey of educators was completed. The findings of this survey established an enthusiasm by classroom teachers for the *Wonderwise* kits and documented manners in which teachers were modifying the kits for classroom use. The most important finding was that women scientists provided important role models for girls. The strong science activities and materials were seen as educational and inspirational for both boys and girls (Spiegel, Diamond, & Dethlefs 2002).

Wonderwise 4-H Project

The UNSM and Nebraska Cooperative Extension 4-H sought funding through NSF for the development of a series of nonformal science education modules that would focus on inquiry-based science activities for youth. The purpose was to expose youth, especially those in rural communities, to talented women scientists in the world. Prior to seeking funding, formative evaluation took place among Nebraska Extension Educators to establish a picture of the curriculum needs.

Formative evaluation. County Extension Educators were surveyed through a needs assessment format. Results of this survey and "listening sessions" with over 700 rural educators found needs in the following areas:

1. Thirty-six percent of respondents rated science and technology education with the highest rating of "extremely important".
2. Twenty-four percent rated diversity education as "extremely important".
3. Computer curriculum was rated first in the category of curricula which was lacking in Nebraska.
4. There is a need to enhance science literacy among young people.
5. There needs to be help recruiting young people into scientific fields (Diamond & Heseul, 2000).

The 4-H *Wonderwise* curriculum was designed to address these needs.

Modifications to Wonderwise kit. Three new learning kits were designed to meet the needs of 8 to 12 year old youth. The kits would not just replicate the previous kits, but would feature one woman scientist and one science discipline. The new kits were developed to meet the needs of 4-H's nonformal education settings.

Previous kits were modified to meet these new standards after trail testing with 4-H youth from various states. Each kit would now contain: a video, activity booklet featuring five inquiry-based science activities, CD ROMs containing a biography of the scientist, down-loaded versions of activities, additional resources and activities, and controlled access for exploring additional resources on the Internet.

New kit topics. Three new kits were developed. The method used for trial testing the initial kits were used to test new kits prior to distribution. Kit topics included:

1. *Space Geologist* featuring Diana Campos, Ph. D., as she explores craters on earth and biological time.
2. *Vet Detective* features Tolani Francisco, DVM, as she learns about wild animals behavior, physiology, and digestion.
3. *Genetic Counselor* features Cathy Burson, Ph.D., as she works with a young child's experimental treatment for a rare genetic disorder.

Women's Perception of Science and Scientific Careers

Few young people interested in science and technology pursue the interest when they become adults. Further, boys are more likely than girls to follow interests into science careers (Lee, 1998). While the gender gap in academic achievement in science has gradually been decreasing, girls' interests still lag behind boys as they progress through school (O'Sullivan, et al., 1997; Speigel, et al., n.d.). Additionally, at the completion of their education, females remain vastly underrepresented in science professions (National Science Board, 1993). Though women are 46% of the national workforce, they only make up 22% of the scientist and engineers (National

Science Foundation, 1999; Davis, 2002). Within this group of scientists and engineers, 18% are white, 2% Asian, 1% Black, 0.7% Hispanic and 0.1% Native American. Within the science community, white women are few in number, women of color are even fewer in proportion (Davis, 2002). Several factors are attributed to why gender differences exist, including gender stereotyping (Sadker & Sadker, 1994; Spiegel, et al., n.d.) and a lack of virtual and real role models (Baker, 1987).

Research indicated that there was not inherent reason for under representation in science of women, African Americans, Latinos/Latinas, Native Americans and other groups; rather the social forces perpetuating their exclusion were subtle, complex, and intransigent (Clewell & Anderson, 1991; Gibbons, 1992; Linn & Hyde, 1989; Oakes, Ormseth, Bell & Camp, 1990; Zuckerman, 1987; Nicholson, Weiss, Campbell, 1994). In the United States, women (as well as certain minorities) are proportionately underrepresented in most scientific and technological disciplines (Lee, 1998). Despite recent advances, females continue to be underrepresented in the sciences, and their attrition rates are higher that those for men (National Science Foundation, 1982). Disparities are often said to result from background factors that put children at a disadvantage in quantitative disciplines. One example of a missing background factor is a lack of role models (Hardin & Dede, 1973; Koch, 1992; Sloat, 1992; Lee, 1998). Accumulated research suggests that girls' disadvantage may lie in the way educators cultivate interest rather than how they ration or restrict opportunities to learn (Fennema, 1984; Fox, 1980; Oakes, 1990; Reyes, 1980; Wilson & Boldizar, 1990; Lee, 1998).

Gurian (2001) attributes differences in academic achievement to biological and gender differences which affect how children learn. He synthesized brain-based research to document differences in male and female development. Based on these differences in brain development, he described the ultimate elementary learning experience for girls to include telling of stories and using images of girls and women who are competent and who model varieties of mature female behavior. Additionally, he advocates providing concrete manipulative materials to touch and sense when teaching science.

Concrete manipulative science is not happening in many classrooms. Emphasis is still placed on traditional teaching methods by 40% of elementary teachers and 69% of high school teachers who rely on textbooks for 80% of their teaching (Battista, 1999; Kohn, 1999). In science classrooms, strides have been made in "hands on" activity as a popular teaching tool, yet lecturing and textbooks continue to dominate the teaching style of most teachers. During an interview with an adolescent girl who considered herself "good at science," Brickhouse, Lowery and Schultz (2000) asked how to succeed in science class. This young woman's answer demonstrates how far we have to go: "Science is easy. All you have to do is sit there and listen." Females in other studies have described science as boring and a memorization of facts. In science classrooms, males receive more attention from teachers than females do. They are called upon to answer questions more frequently, given more freedom to call out answers, and receive more specific detailed feedback on the process and quality of their work (Jones & Wheatley, 1990; Kahle & Lake, 1983; Sadker & Sadker, 1994; Tobin, Kahle & Frasier, 1990; Greenfield, 1997).

Adamson, Foster, Roark and Reed (1998) found a significant difference in science projects selected by males and females. Females were more likely to work within the area of social and biological sciences and boys within the area of physical science. Girls rate physical science among their least liked subjects as early as elementary school (Andre, Whigham, Hendrickson & Chambers, 1999). This creates a cause for concern when one considers the lucrative, technological careers that require physical science training.

Societal expectations for females seem to carry out the stereotype that science is a man's field. Andre, Whigham, Hendrickson and Chambers (1999) found that parental expectations on science achievement and competence differed for females. This study indicated no significant differences appeared in parental perceptions of importance of mathematics or reading across grade level or gender differences. However, there were significant differences in parents' perceptions of the importance of science. Parents perceived science as more important for older children and males. Additionally, there appeared to be no significant differences in parents' expectations of their child's performance in math, reading, language arts, computer science, art, or social skills as a function of gender. However, parents expected higher performance from boys than girls in science. Perceptions of their parents can be a powerful developmental influence on how children perceive themselves and their ability. These perceptions can cast influences on expectation of success, interest in school subjects, and career choices.

Along with traditional methodologies, there appears to be a difference in how teachers perceive young women who are "good" at science. Brickhouse, et. al.,

(2000) noted in their observations with middle school science teachers that referrals for honors high school science courses were made based more on students' behavior in class and study habits, rather than on their interest in science or need to be challenged by science in the classroom. Additionally, two young women who were studied in a multiple case study had interest in science and did science type activities outside of school, such as fixing machinery with a father or collecting rocks. Neither of these young women were seen by teachers as being good at science or needing to be challenged. Furthermore, both of these young women's behavior deteriorated in science classes which were taught through traditional methods of lecture and textbook writing activities. This raises questions about whether individuals encouraged by educators to take higher level science classes are actually the females who will stay most engaged in science.

Formal educational experiences appear to be different for females than males, parental expectations appear to differ, and an additional factor seems to include a difference in informal science experiences between males and females. Kahle and Lakes (1983) and Jones, Howe, & Rua (2000) were among the first to establish that females have different out of school experiences than male peers. More boys than girls indicated reading science articles, viewing science television programs, visiting factories, weather stations, or electrical plants.

Constructivist-based research suggests that informal science-related play and toys lay the foundation for a child's development of science concepts and attitudes about science (Kelley, 1978; Tracy, 1990; Jones, Howe & Rua, 2000). Yet cultural norms seem to view science as masculine. Additionally, even programs set for older females in informal settings, seem to encounter this unending cycle of dual message to females. As a society, we push youth to get an education as a way to ensure financial security. Yet Brickhouse and Potter (2001) found that college educated women working for an inner city after school program to promote positive attitudes toward science in nonformal science learning settings for girls, were making poverty level wages. The women were working in a part time position with no benefits. The situation gives girls a contrasting message: getting an education in science does not ensure financial success.

Some strides are occuring. Greenfield (1997) states that regional disparities can exist. She investigated a “nontraditional” situation in which girls’ enrollment equals or exceeds boys in advance science and mathematics classes in a specific school district. Females within her study still expressed more negative attitudes toward science than males. Classroom practices reflected some of the same norms as found nationally, yet differed in a variety of ways. Strong female role models existed at the elementary school level. Elementary science classes were taught by female science specialists using a nontraditional constructivist inquiry based model. In science classes, females generated as many questions as males. Females received praise and detailed feedback at a similar level to their male peers. Furthermore, females more active participation through small group situations in the science classroom extended to the use of equipment and experimentation at the high school level. Girls did not always express a strong interest in secondary science or have a strong science nonformal background. They were, however, studying science seriously at most grade levels.

Reasons proposed by Greenfield (1997) to understand this phenomenon included the inquiry based elementary teaching strategies used to enhance girls' attitudes and participation at a secondary level; and girls' desire to enhance their chances for college admission encouraged them to actively participate in advance mathematics and science placements. The findings of Greenfield's study reinforce earlier studies and make implications for teachers and adults working with young women in both formal and nonformal settings. Greenfield stresses a need to be using gender-equitable practices, provide girls with female scientific role models at an early age, laboratory work needs to be hands on and inquiry based, and collaboration needs to happen in all structured and unstructured learning centers that allow girls to be active participants in science related activities. This research also suggests that there is hope that girls can be seen as a regular and dominant presence within science classrooms.

Based on the implications of the research present, it appears that changing how children are taught is not enough. Societal changes also need to occur. For women to advance into careers in the physical science arena, there must be changes in the manner in which girls are exposed to science at home and in other nonformal science settings throughout their lives. Gurian (2001) writes that each environment a child is present in is in some way a learning experience for that child. As long as society continues to expect less of females in science, there cannot be changes in the career statistics.

This can be particularly true of young women interested in non-traditional careers in areas of science, math, or engineering. Rural communities, like those served by 4-H, lack not only the role models for these non-traditional careers, but also the educational resources and activities to encourage and sustain an interest in math and science beyond the elementary years (Diamond & Heusel, 2000).

A group of 8^{th} grade rural girls, who were identified as interested and talented in science, showed a decreasing interest in pursuing a science career as they were tracked through high school by the NSF-funded WISE project (Jacobs, Finken, Lindsley-Griffin, & Wright, 1998). This appears to be a trend beyond rural areas. Among graduating seniors of 1990 who scored above the 90^{th} percentile on the mathematics portion of Scholastic Aptitude Test, girls were found only two-thirds as likely as boys to indicate plans for a career in science or engineering (Matyas & Dix, 1992).

Nonformal and Informal Youth Education

Informal education is voluntary and self-directed, life long, and motivated mainly by intrinsic interests, curiosity exploration, manipulation, fantasy, task completion, and social interaction. Informal learning can be linear or nonlinear and often is self-paced and visual or object-oriented. It provides an experiential base and motivation for further activity and learning. The outcome of an informal learning experience in science, mathematics, and technology includes better understanding of concepts, topics, processes, and thinking in scientific and technical disciplines, as well as increased knowledge about career opportunities in these fields (National Science Foundation, 1982).

Nonformal education is any intentional and systematic educational enterprise. It is usually outside of traditional schooling in which content is adapted to the unique needs of the students, or unique situations, in order to maximize learning and minimize other elements which often occupy formal school teachers (i.e., taking roll, enforcing discipline, writing reports, etc.) (Kleis, 1973; Etling, 1993).

Whether in the adult education arena or the nonformal settings of 4-H, the experiential model presented is based on a simple premise of learning: change and growth are best facilitated by an integrated process. Both models require individuals to go beyond the experience to begin to synthesize through reflection, use of prior knowledge and to generalize information. Both models require active cooperation between the facilitator, the 4-H leader or teacher and the learner. The facilitator's role is to provide guidance. Learning occurs within this model when the learner, whether adult or youth, is encouraged to explain his/her ideas to peers and defend their view points to others.

Experiential Models

Experiential Model and 4-H

For over 20 years, nonformal education programs such as 4-H have promoted an experiential approach to learning (Joplin, 1995 ; Carlson & Maxa 1998). Experiential learning is based on a model designed by Pfeiffer and Jones and includes several stages within the model, including the experience, time to communicate and share observations, process time to allow for analysis and reflection, generalization which allows for relating the experience or activity to the real world, and application, which allows for use of what was learned in a similar situations. (Figure 1.1)

Nonformal education, such as 4-H, allows learners to control the objects of their own learning while in turn it presents opportunities to construct their own knowledge. The 4-H model of experiential learning engages youth and encourages learning by doing (Carlson & Maxa 1998): it is included in a many of the 4-H materials to help explain the expectations for learning in the nonformal educational setting. Leader guidebooks encourage leaders to sit back and allow youth the opportunity to explore and figure things out, with the adult leader serving as a facilitator through open-ended questioning formats (Figure 1.1).

Adult Experiential Model

Lewin's adult experiential learning model (Kolb & Fry, 1998) is a four stage cycle consisting of a) here and now experiences, b) collection of data and observations about the experience, c) analysis and conclusions drawn from this analysis are fed back to individuals within the experience, and d) modification of the individual's behavior and choice of new experiences (Figure 2.2).

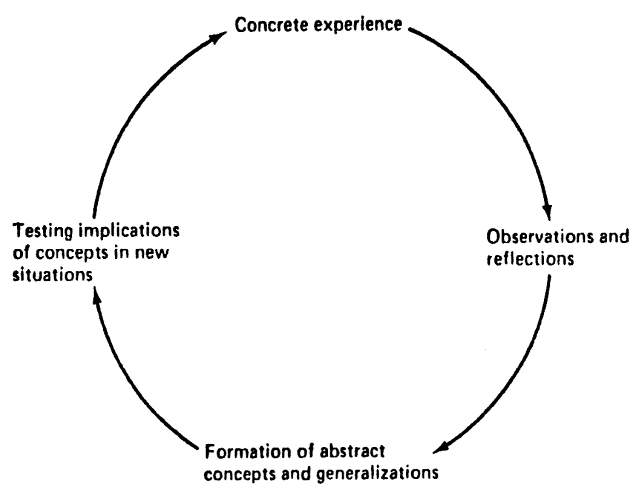

Figure 2.2. Adult Experiential Model

Kolb and Fry (1998) have looked at four specific implications of the experiential learning process:

1. The integration of the cognitive and socio-emotional perspectives on learning.

2. The role of individual differences in learning style.
3. The concept of growth and development inherent in the experiential learning model.
4. A model of learning environments that is commensurate with the experiential learning process.

Each implication helps to explain the experimental learning process from both an adult education and 4-H perspective.

Implication one: The integration of the cognitive and socio-emotional perspectives on learning. Learning is a constructivist process. Both adults and youth construct learning. Adult learners see learning as a process based in experience versus an end product and linked to self. Learning provides the framework to act on and make sense of the learner's world. The experiential learning model takes this further by emphasizing that learning and change result from the integration of concrete emotional experiences with cognitive processes. Of central importance is the idea that learning is, by its nature, a tension and conflict filled process. The process moves the learner from observer to doer and onto some manner of reflective analyzer. Individuals, both adults and youth, as a result of their experiences, develop personal learning characteristics which revolve around theses conflicts.

Implication two: learning style. As a result of heredity, social experiences, and other demands in our environment, individuals develop a learning style. This style emphasizes some learning abilities over others. Each individual, whether youth or adult, has learning strengths and weakness. Kolb and Fry developed a simple self-describing inventory, The Learning Inventory (LSI). This inventory is based on four basic learning abilities a) Concrete Experience (CE), b) Reflective Observation (RO), c) Abstract Conceptualization (AC), and d) Active Experimentation (AE). The inventory yields six scores and two combination sores. From these scores, four dominant learning styles emerge: Converger, Diverger, Assimilator, and Accommodator.

Kolb (1984) believes that matching an individual's strengths within the inventory helps adults to understand and select career fields that are consistent to their learning styles. For example, a Converger's dominant learning abilities are AC and AE. This individual excels in practical application of ideas. They prefer to deal with things rather than with people. This learning style is characteristic of many engineers. Where a Diverger is best at CE and RO, this individual excels in ability to view concrete situations from multiple perspectives. This learning style is characteristic of many individuals with liberal arts and humanities backgrounds. An Assimilator excels in AC and RO. This individual likes creating theoretical models. This learning style is characteristic of math and science majors. Finally the Accommodator is best at CE and AE. This individual likes carrying out plans, experiments, and involving self in new experiences. This individual is a risk taker. Graphing of LSI scores to undergraduate majors on a learning style grid has illustrated a consistency in Kolb and Fry's theory.

Similarly, according to Rodriguez, Hirschl, Mead, & Goggin (1999), many youth go on to college and follow disciplines based on their positive involvement in 4-H club programs (e.g., studying water quality in 4-H may lead to studying biology in college; animal club members may go on to study pre-med or veterinary science).

The majority of youth surveyed by this team reported that they had developed skills in leadership, public speaking, self-esteem, communication, and planning. Additionally, 4-H youth reported improvement in school performance and a desire to make a difference in their communities.

Implication three: growth and development. From a broader perspective, learning becomes central to life and how one learns affects personal development. The experiential learning model provides a means to map this development. Kolb stresses three broad developmental stages. The first stage is Acquisition; it extends from birth through adolescence and marks a time when individuals are acquiring basic learning abilities and cognitive structures. The second stage is Specialization which extends through formal education and early adult life experiences. The final stage is Integration, when the adult must reassert or adapt modes of non-dominant learning styles to adapt to outside expectations, career choices, etc.

When comparing the adult learning model to the 4-H model we are basically dealing with individuals within different stages of growth and development yet similar needs for open-ended learning experiences.

Implication Four: environment. Whether working with adults or children, the environment plays an important role and affects learning. Environment cannot be addressed as the formal learning environment generally described in formal settings. An experiential learning model environment must be one in which people of all learning styles have their needs met. This type of environment includes factors for doing, reflecting, assimilating and rethinking of knowledge. These are the very factors on which both the adult and 4-H experiential models are built. Nonformal education allows learners to control the objects of their own learning, while in turn it presents opportunities to construct their own knowledge. The model of experiential learning engages youth and encourages learning by doing (Carlson & Maxa, 1998).

The models are both cyclic in shape. Though development is credited to different individuals and each model uses different vocabulary, both models describe the same cycle of learning. 4-H breaks this cycle down into more steps or increments, yet, generally the steps between the two models are more similar than different. The greatest difference seems to be in the age of the learner, not in the need for experiential learning opportunities.

How does *Wonderwise* fit into this scenerio of experiential learning? The *Wonderwise* curriculum was designed to motivate children, especially females, to pursue careers in science. The goals included children experiencing and identifying with the female scientists featured in each *Wonderwise* kit. Additionally, each kit is designed to facilitate children's active involvement in science activities/experiences related to actual work of the featured scientist. The follow-up reflection activity within each kit, called Pulling it all Together (PIAT), meets the final stage of the model as it encourages children to create a story about a scientist who does similar work to the scientist featured within the kit (Diamond,et al., 1996). Kolb (1984) says that knowledge results from the interaction between theory and experience.

Significance of Adult Role Models

The very nature by which we value others by becoming like them is referred to as identification. The nature of identification is consciously trying to become like someone we admire. We focus on the qualities of another to expand and modify ourselves. According to Josselson (1996), this is necessary for growth. This is the process role models play within the lives of those who attempt to emulate them. As a form of relatedness, however, identification is not defensive, but expansive. Because we admire, we attempt to own a particular quality. Admiration and efforts to emulate others form a central aspect to people's experiences with other people. Adolescents and young adults who are still shifting through the possibilities for their own identities, are most likely to highlight specific qualities of others (Josselson, 1996). Children consciously strive to become like their parents and other adults, to do the admirable things that they can do. Learning, in this way, becomes a form of love (Josselson, 1996).

Identifying with certain adults as role models, indicates the youth believe that this individual is worthy of imitation in respect, attitudes, and values (Bryant & Zimmerman, 2003, Bell, 1970; Pleiss & Feldhusen, 1995; Taylor, 1989). Adults serve as key references to adolescents by providing a window to the future, positive behavior models, and successful adaptive behavior techniques (Kemper, 1968). Significant adult role models who are involved in adolescents' lives are usually found in immediate and extended family (Bryant & Zimmerman, 2003, Blyth & Foster-Clark, 1987; Hayes & Mindel, 1973; Hendry, Roberts, Glendinning & Coleman ,1992; Shade, 1983) .

One of the most common experiences reported by individuals in vital encounters with others was a feeling of having your awareness expanded. Individuals talked of people who offered them something of interest and lead them onto an enlarged experience of themselves. People, especially women, move along through this world through relatedness connections (Josselson, 1996).

Staub (1978) suggested that a model's effectiveness may be determined by the degree in which the individual identifies with the model. This may be determined by the similarity to the observer. Under many conditions, same sex models are more effective than opposite sex models in eliciting imitation (Bandura, Ross, & Ross, 1961; Malcoby & Wilson, 1957; Owens & Ascione, 1991). Bandura (1977) suggested that the increased effectiveness of a role model from one situation to another may be influenced by a generalization that occurs between situations and models. He suggests that the strength of an unfamiliar role model's influence varies according to how similar the individual is to previous role models whose behavior, when imitated, was successful. Similarity in attitudes, interest, and activities often overlaps, according to Bandura with variables such as familiarity.

Research has shown an association between career choice or decidedness and the influence of role models (Ragins, 1997; Perrone, Zanardelli, Worthington & Chartrand, 2002). Researchers believe that contact with prominent female achievers can help girls overcome their lack of interest in a science career (Baker, 1987: Diamond & Heusel, 2000). The American Association of University Women (1992) state any contact with scientists and their activities can help girls reduce negative sterotypes about research based discipline and begin changing attitudes about science. Betz (1989) described the importance of role models and mentors in promoting positive career development, particularly for women. Mere exposure is not always sufficient. Role models can influence career indecision in a variety of ways. First, the individuals must seek to build a high quality relationship with the role model. Role models may influence an individual's career decision, not only by direct modeling and imitation, but also by offering support and fostering a healthy relationship with the individual (Perrone, et al., 2002).

Previous research tells us that there is a need to better understand children's thoughts about science and scientific careers. The impact nonformal educational settings have on these thought processes needs to be explored. Usually, children are tested in formal educational settings to measure what they have learned. Formal education generally takes place in a classroom within a standard school setting. Science is part of the regular curriculum, with everyone participating in the same lesson with the same expected outcomes. Measurement of learning becomes a matter of comparing test scores. This is not an option in a nonformal setting. This type of educational setting provides an individual with diverse and open-ended experiences. Assessment of learning in this format is a challenge. Formulating and understanding how learning takes place in this type of environment, through experiences, requires an understanding of experiential learning models.

Chapter III

Methods

Design of the Study

This research used a qualitative research process to (a) explore how children participating in an experiential learning module (i.e., *Wonderwise* 4-H curriculum) in nonformal educational settings connected to science and a scientist role model and (b) to better understand how children incorporated the subject matter into their thinking.

Wonderwise 4-H science curriculum was an appropriate subject matter to study because it moved a successful formal education curriculum into a nonformal setting. This study gathered information directly from the youth using *Wonderwise* 4-H kits through their involvement in 4-H programs and special events. 4-H is one of the largest youth organizations in the world reaching youth in both rural and urban settings through a nonformal educational context. The nature of the organization, programs and events required a less formal means for interacting with children than a formal classroom.

The case study method allowed the evaluation team time to see the whole picture while participating in the event or program with the children. It allowed for face-to-face interactions and documentation of children's work. This qualitative case study design focused on gathering information that provided an understanding of the manner in which children think about the content and concepts at hand. Denzin and Lincoln (1994) note that with much qualitative work, case study research shares an intense interest in personal views and circumstances.

Additionally, this project allowed for individual contact with youth immediately following interaction with materials and activities from the *Wonderwise* 4-H curriculum. This allowed researchers to understand program activities and impacts through descriptive detailed information about what occurred and how the people in the program reacted to the phenomenon (Patton, 1990). Some of the richest information about nonformal science education is found in qualitative studies (Crane, Nicholson, Chen & Bitgood 1994). Observation and documentation of the programs in action was a necessary component in understanding the nature of intervention. Detailed notes on the environment, the interaction of youth and adults, the interaction of youth to peers and how youth use tools and technology in science, make it possilble to know what was responsible for an individual's persistence views, performance or confidence in science.

Research Questions

The grand tour question was: How did the use of *Wonderwise* 4-H curriculum kits in a nonformal educational setting affect the ways children think about science and scientists?

Specific sub questions included:

1. In what manner did individual children identify with the role models in the *Wonderwise* 4-H curriculum kits?
2. How did children use the activities and videos in *Wonderwise* 4-H as they incorporated subject matter into their thinking?
3. What patterns emerged as the children incorporated the subject matter from the 4-H *Wonderwise* kits into their current knowledge?

Overview of Data Collection and Analysis

Data Collection Processes

Data was collected in three areas to explore the impacts that independent experiential learning (i.e.*Wonderwise* 4-H) had on youth in nonformal educational settings. Data was collected through:

1. Field notes used to observe youth interaction with curriculum materials, peers, and adults.
2. Individual interviews conducted to probe into children's thinking about science and to contribute to understanding the children's stories and drawings.
3. Children's drawings and written storieswhich illustrated their understanding and application of concepts and how they connected to science and scientist.
4. A card sort activity was conducted to probe into children's thinking about people who do science.
5. Relationship maps were drawn by youth interviewed highlighting important individuals within their relationship network.

Institutional Review Board

Approval for the study was received from the Institutional Review Board (IRB) of the University of Nebraska-Lincoln in May 2002 (Appendix C). Parental consent and participant consent were required by the IRB prior to participants being interviewed. Individuals being observed and PIAT forms collected on site and off site were seen as passive data, which protected the identification of individuals. These forms did not require parental or participant consent for collection.

Data Collection Team

Data was collected by a two-member research team. The team worked together to conduct field note documentation and individual interviews of focal subjects. The team completed trial interviews and field note observations, prior to using either, on a research site. The team checked accuracy and clarified the observational goals and how to focus the observation, prior to gathering the field notes at the research sites. Additionally, continual checks by the team took place throughout the project to insure accuracy and consistency in the data collection process.

Data Analysis

Field notes and interviews (Patton, 1990) were be used to develop a subject profile for each subject. Observation provided a check on what was reported in interviews. Interviews, on the other hand, permitted the observer to go beyond external behavior to explore the internal states of the person observed. This profile contained quotes, observed behaviors and interactions. This profile served as a means to extend knowledge about the individuals interviewed and helped provide insight into the youth's personality, thought processes and lifestyle.

Data from the Children's drawings and/or written stories (PIATs), card sort and relationship maps were triangulated with the profile to further describe how this participant connected to the scientist, science and experiential learning experience.

Triangulation

In triangulating the data, researchers looked for (a) how the content of the kit connected to the subject matter for the individual subjects, (b) how youth connected role modeling, and (c) how youth made application connections to the subject matter. Data from all areas - observation field notes, documentation of youth's work and individual child interviews including the card sort and relationship maps were used in the triangulation process.

Field Notes

Subjects at Data Collection Sites

Sites. Sites selected based on five basic criteria established to insure a sampling of diverse program settings typical of 4-H, ethnic population and age of participants. Additionally, a balance between rural and urban settings was also sought (Table 3.1).

Six sites were selected from within the three states that met the specific criteria. Each site was identified because it met the following criteria:

1. Participating 4-H youth attending were between the ages of 9 and 12.
2. The program usage fell into one of the established 4-H settings, including overnight camps, day camps, special events, 4-H clubs or after school programs.
3. Ethnicity of children attending met goals set by the research team to represent a spectrum of individuals.
4. The program had the ability to acquire appropriate parental consent forms prior to research team site visit.

5. The program planned use of *Wonderwise* 4-H kits between May 2002 and January 2003.

Table 3.1. Characteristics of Data Collection Sites and Subjects

Site Identification Number	Location	Setting/Program Use
Site 1	Suburban setting out side a large Midwestern city.	Special event: overnight event for girls at a children's museum.
Site 2	Rural setting outside the Black Hills	Overnight camp
Site 3	Urban setting in a small Midwestern city	Special event: summer enrichment program
Site 4	Urban setting in a Midwestern metropolitan area	After school program
Site 5	Rural area	Day camp
Site 6	Rural area on a Native American Reservation	After school program

Specific subjects. Criteria were established to insure diversity in selection of 4-H youth. One of the goals of *Wonderwise* 4-H was to encourage individuals from groups typically underrepresented in the science professions to develop interests in science. Researchers also set goals for selection of female youth and youth from the ethnic/minority groups identified (Table 3.2).

A stratified participant design to identify the specific subjects for the study were based on the following criteria:

1. Youth in the 9 to 12 year old age range who completed grade four and will be entering grade five.
2. Equal representation of male and female participants.

3. Ethnic representation of Caucasian/Asian, African American, Native American, and Hispanic populations.
4. Youth, who have viewed the *Wonderwise* video, completed at least one activity from the same kit and completed the PIAT.
5. When the first 4 criteria were met by multiple individual subjects, adult leaders helped select focal subjects based on youth's verbal abilities and comfort level with new adults.

Table 3.2. Stratification Design

Site identification number	**Gender of subjects**	**Ethnicity of subjects**
Site 1	5 Females	4 Caucasian 1 African American
Site 2	2 Females 2 Males	3 Caucasian 1 Hispanic
Site 3	2 Females 2 Males	3 Caucasian 1 African American
Site 4	2 Females 2 Males	1 Caucasian 1 Hispanic 2 African American
Site 5	4 Females	4 Hispanic
Site 6	2 Females 2 Males	4 Native American

Field Note Data Collection Instrument

Patton (1990) suggests that a checklist can be relied on to guide some aspects of field work. However, according to Patton, it is impossible to observe everything so some process of selection is necessary. The purpose of observational data was to describe the setting, the activities that took place and the individuals who participated in those activities. Therefore, the field note format was developed for the observation to guide members of the traveling research team in documenting the environment, behavior of focal subjects and language they used. The entire instrument can be found in Appendix G.

The field note document contained three columns. The first column allowed the observer to document a description of the site, environment, activities, adult interactions, language and behaviors. The second and third columns were used to document the focal subject's interactions with peers, video, materials and science activities (Table 3.3).

Table 3.3. Form for Recording Field Notes

Description of site
 	
# youth # teens # adults 	
# small groups 	
#youth/group
Leaders(s)
Gender
Ethnicity
Age
	Focal Subject ___
	
	Gender
	Ethnicity
	Age
	Description
		Focal Subject ___
		
		Gender
		Ethnicity
		Age
		Description

Description of activity		

Field Note Data Collection Process

It was estimated, that between 150 and 200 4-H youth were observed by members of the research team. Out of this number, focal subjects were selected for field notes and the personal interview process. The purpose of this selection allowed researchers to better understand how individual youth used the *Wonderwise* 4-H activities through documentation of the insider's perspective or "the emic perspective" (Fetterman, 1989). Focal subjects allowed the research team to gain quotes and anecdotes of behavior needed to richly describe the individual (Diamond, 1999). Each member of the research team observed the two individuals selected for the interview while they viewed the video and completed the science activity and children's drawing and/or written story (PIAT)

Field Note Data Analysis

Field notes were read and analyzed for:

1. Quotes and behaviors that describe children's interactions and thought processes.
2. Activities including informal interactions and unplanned occurrences.
3. Nonverbal communication patterns.

A focal subject description was completed for each subject based on observations gained through field notes. Focal subjects were compared to identify patterns of similarity and dissimilarity in identification with science and scientist.

Semi-Structured Individual Interviews

Subjects

Twenty-five youth were targeted for in-depth data collection. They were 9-12 years old who participated in the *Wonderwise* portion of a 4-H event (i.e., nonformal education) in three Midwest states. The specific youth were selected from six different sites after field notes were completed by observing youth as they completed a *Wonderwise* experience from one of five *Wonderwise* kits:(a) *Vet Detective*, (b) *Urban Ecologist*, (c) *Space Geologist*, (d) *African Plant Explorer*, or (e) *Pollen Detective*. The *Wonderwise* experiences included watching a video featuring the *Wonderwise* scientist, completing at least one of the activities from the *Wonderwise* curriculum and drawing a picture or writing a story about the video. The in-depth data was then gathered from the selected youth through semi-structured interviews, the stories or drawings about the scientist (i.e., the PIATs), a relationship map they drew, and a card sort activity. See Figure 3.2, p7 for a sampling.

The 25 subjects were interviewed by the two-member research team. Individuals were given a subject identification number based on the site code (the first three numbers) and a letter designation as participant A, B, C, or D at each site. Although the stratified participant design called for equal representation of gender, age, and ethniciy, those interviewed digressed slightly from the design because the available subjects were limited by the nature of the participant make-up at the sites. The age represented the desired stratification but there were twice as many females as males and nearly half of the sample were Caucasian (Table 3.4).

Table 3.4. Actual Stratification of Subjects

Gender		**Age**			**Ethnicity**			
Male	Female	9	10	11	African American	Caucasian	Hispanic	Native American
n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
8 (32)	17 (68)	6 (24)	13 (52)	6 (24)	4 (16)	11 (44)	6 (24)	4(16)

Youth Interview Protocol

A semi-structured interview protocol was developed that used four different data collection processes: open-ended questions with probes, children's stories or drawings (i.e., the PIATs), a card sort activity, and a relationship map. Questions developed by the research team were based on past surveys of *Wonderwise* participants. Questions were cross-checked with the research questions to verify that questions in the interview would help explain the data collected in different data collection processes. The instrument was then verified by the *Wonderwise* evaluation team (Appendix H).

Youth Interview Pilot Testing Process

Semi-structured interview. The interview protocol was pilot tested on three focal subjects in April, 2002, at the University of Nebraska State Museum. Focal subjects were selected from 72 children representing three classes of elementary students visiting the museum as part of the museum's education program. Three youth (one male, two females) were interviewed using the protocol. Youth interviewed met similar selection criteria to those proposed for 4-H study participants. They were Caucasian, age 9 to 10, viewed the *Urban Ecologist* video, took part in a corresponding activity, Cool Tools, from the *Urban Ecologist Kit*, and completed a story or drawing (i.e., the PIAT).

All pilot interviews were audio recorded for transcription. Two members of the research team were present at the time of the interviews. One conducted the interview, the other observed and took notes on (a) the child's behavior, (b) the interviewer's demeanor and questioning style, and (c) possible additional probes that might have been used.

Modifications to the protocol were made based on the observations of the team members upon review of interview transcripts and the observation. Open-ended questions were modified for clarity, order and probes. The probes used to clarify the questions about the subject's story or drawing (i.e., the PIAT) were modified to include questions based on drawings versus written text only. The relationship map based on Josselson (1996) was added after the first interview to help establish patterns of relationships in individual subject's lives. The card sort was modified to use smaller task cards. Larger cards seemed to be cumbersome and difficult to handle. Interviews were projected to take approximately 15 - 30 minutes.

Drawn and written stories. An additional pilot was completed on children's written stories and drawings (i.e., the PIATs) to test the data analysis process. This pilot test was completed by a graduate student outside the evaluation team (Bendient, 2002). Using children's stories and drawings (i.e., the PIATS) from past *Wonderwise* programs and nonfocal subjects an analysis was completed.

The drawings and written stories (i.e., the PIATs) from past *Wonderwise* activities were compiled and photocopied. Children's written stories or drawings (i.e., the PIATs) were collected were (a) all youth participating in the *Wonderwise* 4-H activities from the six research site visits and (b) from other 4-H events, clubs, camps and after school programs, using the *Wonderwise* 4-H program during the time of the study. Sites not visited by the research team were asked to send in children's stories and drawings (i.e., the PIAT s) along with the event demographic information.

Each youth's drawing or written story (i.e., the PIAT) was documented with the youth's age and gender, the title of video viewed, *Wonderwise* experiential activity used, date completed and site/participant identification number. The stories representing *Urban Ecologist, Vet Detective and Space Geologist* kits were analyzed for possible themes and codes present in the drawings/stories. Two major themes emerged:

1. The drawings/stories with people in them.
2. The drawings/stories without people present.

Additional codes were generated based on these two initial categories. Youth's stories or drawings (i.e., the PIAT forms) with person/people were coded based on:

1. Number of individuals represented in drawing/story.
2. Affect of the individual represented in the drawing/story as (a) positive (b) neutral and (c) negative.
3. Degree of similarity of the people/person represented in drawing/story to (a) self, (b) scientist in kit, and (c) other.
4. Degree of similarity of what people/person represented in drawing/story are doing with (a) content/subject of the kit, (b) activities in the kit, (c) video, and (d) other.

Stories or drawings with no people/person represented were coded based on:

1. Degree of similarity of each non-person feature with (a) content/subject of the kit, (b) activities in the kit, (c) video, and (d) other.

Semi-Structured Interview Data Collection Process

Interviews took place at informal settings at all six sites using the semi-structured interview protocol. Youth were interviewed after they viewed the Wonderwise video, completed at least one experiential science activity based on the work of the scientist presented in the Wonderwise video, and completed a written story or drawing (i.e., the PIAT). Each interview was audio recorded for transcription. The youth were wired with a microphone for audio recording and interviewed by one member of the research team. Two researchers conducted interviews simultaneously as children completed a story or drawing (i.e., the PIAT).

Interviews contained four data collection processes:(a) open-ended questions, (b) children's drawings or written stories, (c) card sort, and (d) relationship map.

Open-ended questions. Open-ended questions with appropriate probes were used as the basis for the interview protocol. Questions were asked about the youth's stories and drawings (PIAT), *Wonderwise* activities and video, school subject preferences, career visions, card sort activity and relationship map.

Children's written stories or drawings (i.e., the PIAT). Each *Wonderwise* 4-H kit has a final reflection exercise as a concluding page of the activity guide. This page, entitled "Pulling It All Together" (PIAT) asks youth to create a story about a scientist who does work similar to the scientist featured in the specific kit (Appendix A). This format is similar to the Draw-A-Scientist test described by Mason, Butler, Kahle & Gardner 1991. The purpose of this drawing or writing was to help understand how children incorporated the information about the scientist and the scientist's work in their thinking.

Card sort. Youth picked task cards they felt described people who do science. The task cards from which youth could select were: is a man, is a woman, is interesting, is boring, has kids, has no kids, is fun, is not fun, works outside, works inside, likes work or doesn't like work. Youth sorted these cards into two piles. One pile described people who do science. The other pile described people who do not do science. Youth then read the piles to the interviewer. The interviewer recorded answers and used probing questions to understand task card placements.

Relationship map. Relationship maps were based on the work of Josselson (1996). Youth were asked to draw a relationship map similar to the solar system.

They placed themselves in the center of the map, like the sun. Youth were then asked to place important people in their lives on the map; individuals close to them were to be closer to the center of the map; individuals less important were to be placed further out (Appendix D). Youth were asked to star or add the individual to their map they would most like to be like. Interviewers then went over the map with the youth. The youth explained individuals placed on their map and detailed why they were there. Finally, youth were given a sticker with the face of the *Wonderwise* scientist on it. Youth were asked to place the *Wonderwise* scientist on their map. Discussion followed based on the placement of the scientist on the individual map.

Interview Data Analysis

Interviews were transcribed in a timely manner following the interview, with the interviewer reading each transcription and checking it for accuracy (Appendix I). The completed transcripts were reviewed by research team members for validity. The audiotape was then destroyed.

Open-ended questions. Interviews were read, and codes were established, based on themes that emerged from the text. Questions were analyzed for specific content. The second question asked the youth to describe the activities they took part in from the *Wonderwise* curriculum kit. The third question asked the youth to describe featured scientist in the video they watched. These items were analyzed for connections the youth made with the kit's contents and scientist.

The fourth item was a direct question that asked youth what they liked to do at school. The fifth question asked what they would like to do when they grow up.

The sixth question probed further into specific science related interests. Questions that guided the analysis of these questions were:

1. Were there patterns that emerged around basic subject matter areas in elementary schools?
2. Were there career themes present?

A spreadsheet was used to total and tally results for these questions.

Youth's written stories and drawings (i.e., thePIATs). Written stories and drawings (i.e., the PIATs) by 25 former *Wonderwise* participants were used to develop an analysis process (Appendix F). Consequently, the stories or drawings (i.e., the PIATs) were sorted into two categories: (a) person present in the drawing/story, and (b) no people present in drawing/story. PIATs with person/people were coded according to:

1. Number of individuals represented in the drawing/story.
2. Affect of the individual represented in the drawing/story as (a) positive (b) neutral and (c) negative.
3. Degree of similarity of the people/person represented in drawing/story to (a) self, (b) scientist in kit, and (c) other.
4. Degree of similarity of what people/person represented in drawing/story are doing with: (a) content/subject of the kit, (b) activities in the kit, (c) video, and (d) other.

Stories or drawings (PIATs) with no people/person represented were coded based on degree of similarity of each non-person feature with (a) content/subject of the kit, (b) activities in the kit, (c) video, and (d) other. After the initial classification was complete, the evaluation team reviewed the classifications as a validity check.

Following the initial coding, the verbal stories 25 youth told about their PIATs were read. Recoding took place based on the explanation given by the youth. Analysis of the differences in coding, after hearing the youth's verbal explanations were documented.

Card sort. Results were tallied using a spreadsheet. Percentages reflecting the times each card was selected were examined for emerging patterns of response and unusual responses. Interview transcripts were read and coded to reflect individual subject's explanation of reponses.

Relationship map. Data analysis began with counting and listing individuals found on maps. This listing was then grouped into categories such as family, friends, teachers, pets, scientists, and others. Analysis techniques included: (a) linear measurements from the central individual on the map to other's placement on the map, (b) listings of individuals youth most wanted to be like or starred individuals(*) on each map, and (c) categorization by shape of the map.

Interview transcripts were then read and coded to reflect explanations for map drawings, starred individuals (*), and location of *Wonderwise* scientist.

Chapter IV

Results

The purpose of this research was to (a) explore how children participating in an experiential learning module (i.e., *Wonderwise* 4-H curriculum) in nonformal educational settings (a)connected to science and a scientist role model and (b) to better understand if children incorporated the subject matter into their thinking.

Research Questions

The grand tour question was: How does the use of *Wonderwise* 4-H kits in a nonformal educational setting affect the ways children think about science and scientists?

Specific sub questions include:

1. In what manner did individual children identify with the role models in the *Wonderwise* 4-H kits?
2. How did children use the activities and videos in *Wonderwise* 4-H as they incorporated subject matter into their thinking?
3. What patterns emerged as the children incorporated the subject matter from the 4-H *Wonderwise* kits into their current knowledge?

Overview of the Triangulation Process

Data from the five different collection processes was organized around the topics of (a) science, (b) youth's relationships, (c) the impact of *Wonderwise* has on youth's understanding of science, and (d) how this relationship ties into their network. A triangulation map (Figure 4.1) was then designed which incorporated the influences of the *Wonderwise* experience, previous educational experiences with science and personal history. The figure was then redesigned based on the emergence of major themes and sub themes. The four major points that surfaced into which the data could be categorized to formulate specific themes and sub themes were (a) how youth view science, (b) youth's impressions about who does science, (c) role modeling, and (d) career visions.

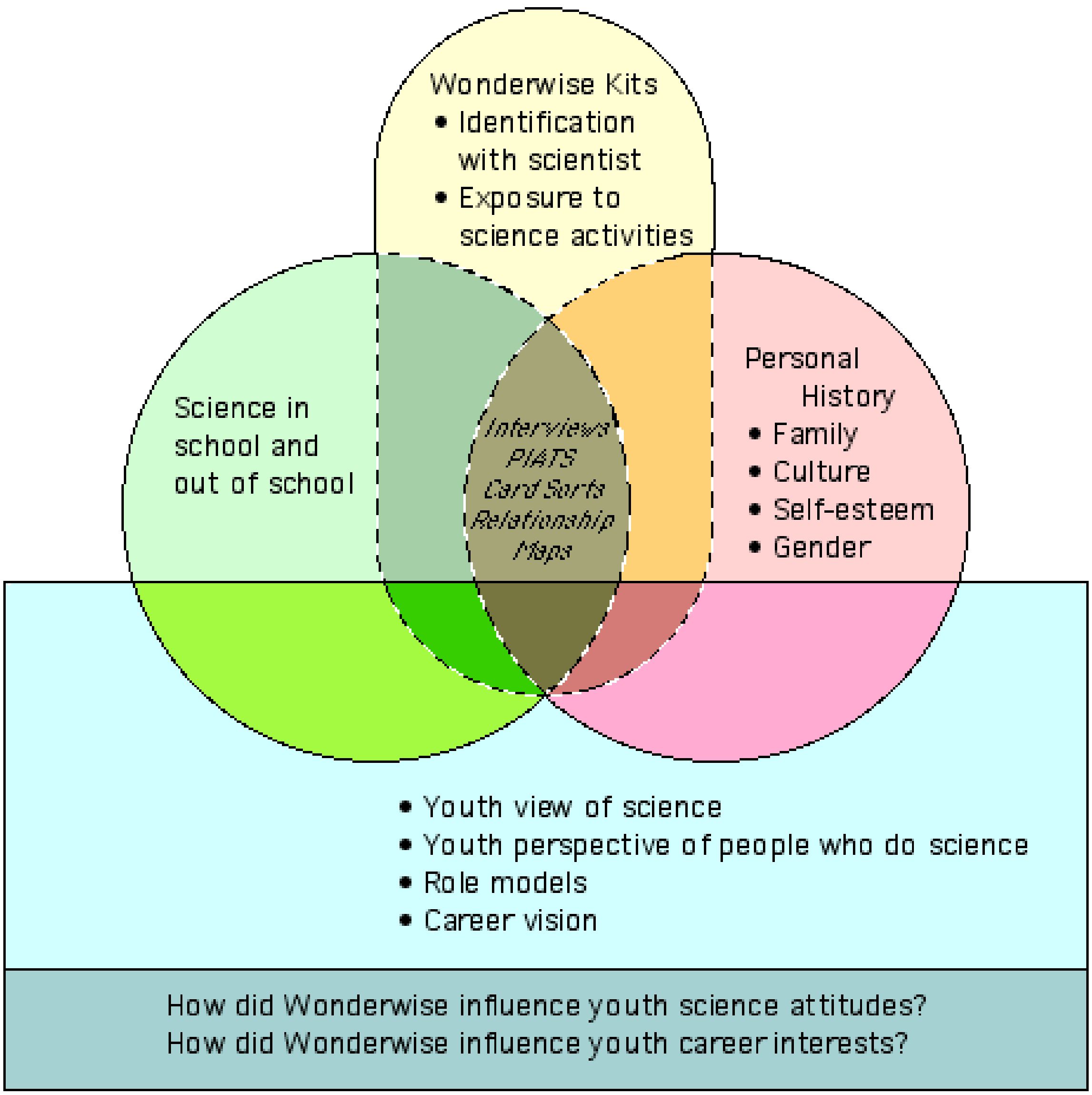

Figure 4.1. Triangulation Map for Data Analysis

Characteristics of the Data Collection Sites

Events youth attended were either specifically designed around a specific *Wonderwise* kit or scientific topic (Table 4.1). Four of the sites focused primarily on *Wonderwise* curricula; youth selected the nonformal educational activity based on the scientific topic (S). At the other two sites, youth could select from a series of activities with *Wonderwise* being one of the activities youth participated in (P). Examples of optional activities youth could select from included archery, arts and crafts, cooking, children's museum exhibits, fishing and rifle shooting ranges. A variety of kits were used at the sites from which the study's sample was selected.

Table 4.1. Site Demographics Overview

Site #	**Kit used**					**Number of Youth**			**Participant Choice**	
	Vet Detective	**Urban Ecologist**	**Space Geologist**	**Pollen Detective**	**African Plant Explorer**	**T**	**Male**	**Female**	**S**[1]	**P**[2]
1	X	X				97	0	97	X	
2			X			54	20	34		X
3	X					15	5	10	X	
4				X		30	11	19		X
5					X	18	5	13	X	
6	X					10	3	7	X	
Total	3	1	1	1	1	224	44	180	4	2

One site was 100% female. The other sites were integrated with both males and females. Females tended to out number males at each site. Males represented less than 20% of the population on each site. Out of five kits used within this data

[1] Site was selected by youth based on *Wonderwise* topic
[2] *Wonderwise* activity was part of other activities offered.

sample, *Vet Detective* was the *Wonderwise* kit used most frequently; all three times it was used, youth selected this activity because it focused on the veterinary topic.

Site One

The all female science overnight event was organized by six extension educators from Northwest Illinois. There were seven 4-H staff, four Discovery Center staff and ten teen leaders, all female, who worked together to design and implement the event. The 4-H staff had responsibility for registration and leading the *Wonderwise* activities. The Discovery Center staff supervised snacks, meals, freetime in the museum and bedtime. The teen leaders were each assigned a group of about 10 girls. They took roll, assisted during the activities and were supposed to supervise throughout the night.

The event was published through fliers distributed at local elementary schools. There were girls from 38 towns represented at the event. Participants were 4th through 6th grade girls. Through pre-registration, the girls selected the kit they wanted to work with: 80% selected *Vet Detective*, and 20% selected *Urban Ecologist*.

Several items made this site unique. Prior to beginning the *Wonderwise* activities the girls had the opportunity to meet a panel of four local female scientists. The scientist described her work; she also set up displays of equipment and/or other materials in her chosen field, and encouraged the girls to ask about these materials. The scientist included a veterinarian, an outdoor educator at a nature center, a taxidermist from a natural science museum, and a biologist from a local college. The

4-H staff had the girls create a mural depicting what they learned based on their experiences (Figure 4.2 and Figure 4.3).

Figure 4.2. *Urban Ecologist* Mural Drawing

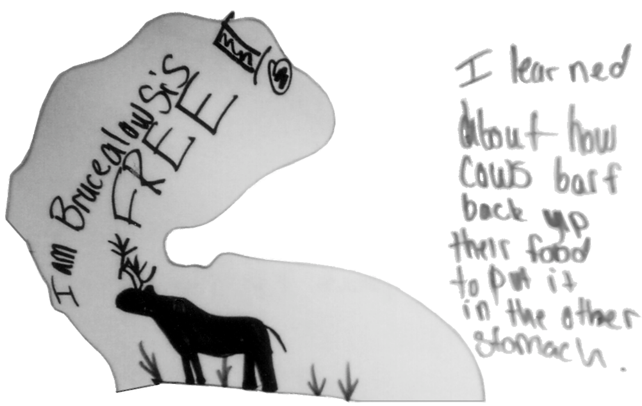

Figure 4.3. *Vet Detective* Mural Drawing

Site Two

The weekend 4-H overnight camp event was organized for youth already involved in 4-H in two counties in Wyoming. The event's schedule and activities were planned by the teen leaders. Many activities were defined by tradition such as the opening evening potluck dinner, skits, campfire routines, Sunday evening dance, Teen Leader Party, and lining up for singing prior to all meals (Figure 4.4). Teen leaders lead activities such as a registration, opening mixer games, scavenger hunt, problem-solving, archery, and riflery. Adults provided supervision on archery, rifle range, *Wonderwise* activities and at the evening campfire. Adults from the community were brought in for specific activities including pottery, screen printing, and a demonstration from Reptile Gardens.

Figure 4.4. Youth lining up for meals at Site 2.

The participants were 8 to 13 year olds; 34 were females and 20 were males. Participants registered for the entire camp. *Space Geologist* was just one of many activities offered for all campers. Youth rotated through all offered activities. Free time allowed youth to return to favorite activities.

Several items on the agenda made this site unique. There was an afternoon camp offered for young children on Sunday afternoon. The campers arrived and spent part of the day using the same facility as the older children. The use of teen leaders at this camp was unique. The teens were indeed in charge. Adults told campers if they had a problem to see a teen leader. The teen leader would help them solve it. If the teen leader needed an adult's help they would get the adult. When youth were involved in the *Wonderwise* activities, all tasks requiring reading directions or filling out worksheet type graphic forms were completed by the adults.

Adults read and walked youth through directions for each task. Youth carried out the activities with adult facilitations. One of the 4-H staff explained to the research team that because it was camp and not school the staff modified reading and "paper and pencil" tasks.

Site Three

The event was a summer enrichment program sponsored by a nonprofit agency. This agency's purpose is to design and implement this program annually. The event lasted for several weeks throughout the summer and offered a broad range of one-week classes for youth. *Vet Detective* was a five-day class meeting in the mornings only. The class was led by a husband and wife who were long-time 4-H club leaders interested in horsemanship. The adults were assisted by one volunteer teen leader.

Participants selected the *Vet Detective* class based on a description published by the community program website or newspaper, which was circulated in local schools and other programs. The program was established in 1987 and is well known in this urban area of Nebraska for the quality of activities it offers annually. The participants were 9 to 12 years old, primarily Caucasian and female.

Several items made this site unique. The *Wonderwise* activities were primarily led by the male adult with some assistance, primarily logistical, from the female adult. There was a lot of down time between activities and activities never took as long as anticipated by adults. Back up activities were not always readily available. Basic class supplies (scissors, tape, or glue), though available through the summer program, were not available to youth. Computers were used to allow for work with the *Wonderwise* CD-ROM and other CD-ROMs on horses. This was the only site in which computers were used. Additionally, this was the only site to take a field trip off site. The youth toured the agricultural facility at a local university.

Site Four

The day camp event was broken into two before and after school programs operating during the summer. One program was visited in the morning and one in the afternoon. The day camp curriculum was developed at the Illinois state level and included: Wonders of Science, which is a combination of the *Wonderwise Pollen Detective* and *Urban Ecologist* activities; Physical Activity is Fun, which includes a snack and active games; and Polish 4-H Adventure, which includes information and experiences about life in Poland. The camp was designed for five half day sessions.

The individual childcare program staff did registration for the event. The 4-H staff provided all the supplies needed for the activities at each site. The regular childcare program's staff stayed with the youth during the activities and assisted 4-H staff when asked. The 4-H staff leader was a college student hired for working summer work. A high school aged student assisted her.

The morning site was one of three sites in the urban area run by a corporation. The location visited was in the lower level of a local church and was for school aged youth only. It is a year round facility that opens all day during summer and before and after school during the rest of the year. Approximately 75% of the children in the summer program attend during the school year also. This was the first time the children had met the 4-H staff.

The afternoon childcare program site was at a community center in an industrial area with the multiple city urban area. The center served children from a very diverse ethnic setting. All childcare staff interacted with the children throughout the activities. The 4-H staff visited this program once a week during the school year and provided activities for the school-aged children. The children were well acquainted with the 4-H staff.

Several items made this site unique. This was the only site where we visited more than one location. There was a large variance between the two locations. One location was clean, and full of materials for children to interact with. The other site was in need of repairs, barren of materials, and cockroaches were present; the children had an on-going cockroach killing contest. All the supplies for the program were packed in plastic tubs that the 4-H staff carried into the room each time they led programs.

Site Five

This day camp event was held in a rural area of Nebraska. The day camp was held separate days; it was offered frequently throughout the summer and less frequently during the school year. The program targeted kids with little or no involvement in 4-H. Publicity was handled through brochures distributed at local stores and 4-H clubs. Summer of 2002 the focus of each day had been a different *Wonderwise* kit. The data collection visit was on the final day of day camp for the summer.

The event was planned and organized by one paid 4-H staff member and a group of teen leaders enrolled in a 4-H club project on leadership. Although it was clear the 4-H staff member was in charge; each 4-H teen leader was expected to take over and lead a portion of the event. The 4-H staff member and 4-H teen leaders had preplanned the event based on *African Plant Explorer* and worked simultaneously, sharing leadership roles throughout the event.

The participants were evenly distributed between 6 and 12 years of age; 66% were Hispanic and 33% were Caucasian. The community was approximately 51% Hispanic. The schools were approximately 71% Hispanic. Three youth were visiting from Mexico and spoke no English; all other participants were either bi-lingual or used English.

Several items made this site unique. The 4-H staff indicated that this community mistrusted outside translators. She requested that all translation between English and Spanish be completed by her or a teen leader. All instructions and materials were in English, except when it appeared an activity was not going as planned. Then four female teen leaders gave instructions in Spanish. The Caucasian and Hispanic children did not readily mix. They sat at separate tables for activities, lunch and during free times. Great care was taken by the adult 4-H staff member to create times through out the day to mix the groups together.

Site Six

This after school event was held in a rural area of Nebraska on a Native American Indian reservation. The after school program was part of an on-going school and community program sponsored through the local school. It offered a variety of services including after school special programs. The event was scheduled around the *Wonderwise Vet Detective* kit. The kit activities were planned and carried out by a paid 4-H State Level Specialist. The after school staff stayed with the youth and assisted as needed.

The two-hour after school event was attended by 10 Native American youth age 9 to 11; 70% of the participants were females. The event was held in the music room in the basement of the elementary school. The room had multiple levels and rows of desks. Several items made this site unique. A blizzard began just prior to the event's start. Throughout the event the school principal made announcements about school closing for the next day and finally called this event to a close one hour early. This was the only site where the *Wonderwise* scientist and the youth participants were from the same ethnic culture, Native American.

Youth's View of Science

Youth were asked about science and their views of science in a variety of ways throughout the interview. Questions focused on (a) preferred subjects and activities in school, (b) what they would do if they did science and elicited their feelings about it, and (c) science video and activities they were involved in while using the *Wonderwise* curriculum.

Two themes emerged from the data. The youth described (a) their perspectives about science, and (b) their science experiences from formal education or informal activities with other people in their lives. These themes were grouped into areas dealing with non- *Wonderwise* experiences such as school experiences, other initiated and self initiated science activities. The descriptions of youth's science experiences were divided according to the *Wonderwise* kit title.

Influences from Non-Wonderwise Experiences

Subject Matter Preferences in School

When youth were asked what they liked to do at school, their responses ranged from specific subjects to eating and recess. Most subjects listed more than one preference. At times subjects listed multiple preferences. Youth described subjects as favorites or used terms such as I like or love Reading and Math. In analysis the first subject mentioned was used as the individual's first choice, second subject mentioned was listed as the second choice etc. Seventy-six percent selected science or math in their choices; 40% selected Science as one of their choices; 48% selected Math as one of their choices; and 48% selected Reading or Language Arts as one of their choices (Table 4.1).

Table 4.2. What Do You Like To Do At School?

Participant	First Choice	Second Choice	Third Choice	Fourth Choice
1	Reading	Music		
2	Math	Science		
3	Division	Reading		
4	Reading			
5	Science			
6	PE	Math	Reading	Drawing
7	Recess	Math	Reading	Science
8	Math			
9	Math	Social Studies		
10	Lunch	Math		
11	Math			
12	Reading			
13	Math			
14	Science	Reading		
15	Outside	Gym		
16	Science	Art	Reading	
17	Math	Outside		
18	English	Science		
19	Paint/draw	Science		
20	Play/study	Science	Outside	
21	Play/learn	Math	Checkers/games	Monkey bars
22	Science	Reading		
23	Computer	Math		
24	Math	Social Studies	Science	Spell/Read
25	Read			

This information was further analyzed based on gender. Out of the 17 females, 53% mentioned Science as a preference and 41% mentioned math for a total of 89% mentioning either science and/or math as a preference. Females mentioned Language Arts/Reading 53% of the time. Out of the 8 males, 12.5 % mentioned Science as a preference and 75% mentioned math for a total of 87% mentioning either Science and/or Math as a preference. Males mentioned Language Arts/Reading 25% of the time (Table 4.3).

Table 4.3. Gender Differences in Youth Choices of School Subject Areas

Gender	Total	Science %	Math %	Language Arts/Reading %
Female	17	53%	39%	53%
Male	8	12.5%	75%	25%

Concepts About Science

Youth told us:

Science isn't easy, but it's fun when we get to do things. (Caucasian female, age 10)

Multiple youth described self as good at science, and liking science. Below is just one example:

I find science interesting and I'm good at it. (Caucasian female, age 11)

Another child described science as:

Science is something you do at school. (African American male, age 10)

Science was described in this manner by a female participant:

Some people think that science is boring, but if you actually get to know it, at school some kids just completely guess on science. They don't even try. And I think people should give more effort to something like that. (Caucasian female, age 10)

Science Experiences at School

Youth described a variety of science experiences outside of *Wonderwise*. Science experiences at school included such things as making ice cream, dissecting frogs and pig eyes, working with batteries, circuits and magnets, learning about life cycles and animal classifications.

> *When I lived in (town), there were these separate buildings that kind of looked like trailers. They were the science room. And we went in there, a teacher just told us we were going to make ice cream, today. And after she talked about the stuff then we went back and starting making ice cream. (Hispanic female, age 11)*

> *I liked it when we saw a pig's heart and when we blew in their lungs. I think we saw a pig's eye and opened it and stuff. (Hispanic female, age 11)*

> *My science teacher was (name), she was my Science and Math teacher. And she let us experience a lot of stuff. She let us have fun! She didn't let science be boring. She let it be fun! It was fun, because we were learning and having fun. You can play games like Bingo, but with animals. See when you play, you had a chart. And you had to write like amphibian or something that you remembered of our textbook and then she would say things, let's say amphibian or something like that. She would say and you would say if you had it. You had to raise your hand. And you were supposed to tell what it was. (Hispanic female, age 9)*

One experience described by a female participant included an egg drop competition. She described the process of designing her egg's package.

> *Cuz at school in third grade we did this thing, we did an egg day, where we had to make egg ships. And we put our egg in the ship and we dropped out of the window on the top floor. And if it didn't break we got a really good grade and um. Mine didn't break! Cuz I just put it together that morning…that was like my favorite day of the whole year! (Caucasian female, age 10)*

Another child described working in a school garden. She talked about being outside, collecting pollen and bringing it inside to view under the school's microscope.

> *I like to go outside and look at the flowers when it's recess time, because we have a garden and after school there's a Garden Club and if you're in it then you can plant flowers around the school and well sometimes they let us go outside and get pollen off the flowers so that*

we can look at it. And feel what it's like in science. (Caucasian female, age 10)

Science Experiences Outside of School

Science experiences outside of school also were described. Youth described rich experiences such as visiting zoos, natural history museums, wetlands and grasslands near their home. Youth described two types of experiences outside of school. Those experiences initiated by others such as parents, grandparents, scout leaders etc….and those that were self initiated.

Science experiences initiated by others. A youth from a rural area described a dinosaur dig on her ranch.

> *These dinosaur diggers came up from Arizona and they found a dinosauron our land and a baby right next to it. They were using brushes and picks and they had these little tubes that you can put little bones in. I mean about that big, as big as a head of a pin. They were very carefullymoving the bones and they make casts of them. They go to Arizona.Arizona is their main state, so they have a museum there and that's where they took our, that dinosaur. (Caucasian female, age 10)*

Another youth described her experiences at the local zoo. Her grandmother made arrangements for her to spend time at the local zoo with a caregiver for the monkeys.

> *I got to go a couple of times. I watched her feed them and train them and that was really cool. (Caucasian female, age 10)*

One youth talked about her family's trip to local wetlands. She compared her experience of wearing high boots to that of Carmen Cid's, the scientist she had just studied in *Urban Ecologist.*

> *We went on a trip to the grasslands and I stepped in a wetlands and I got pretty wet. (giggles) Just a little higher than my ankle. (points to leg) It felt mushy. (Caucasian female, age 10)*

When prompted about this incident she described her boots as follows (Figure 4.5):

> *They're um, kind of hard and like waterproof. I used to have some like those, I don't remember why, But I did. I put them on once and they did not feel comfortable. (Caucasian female, age 10)*

When prompted if Carmen felt comfortable in the boots the individual responded:

> *No! (giggles) (Caucasian female, age 10)*

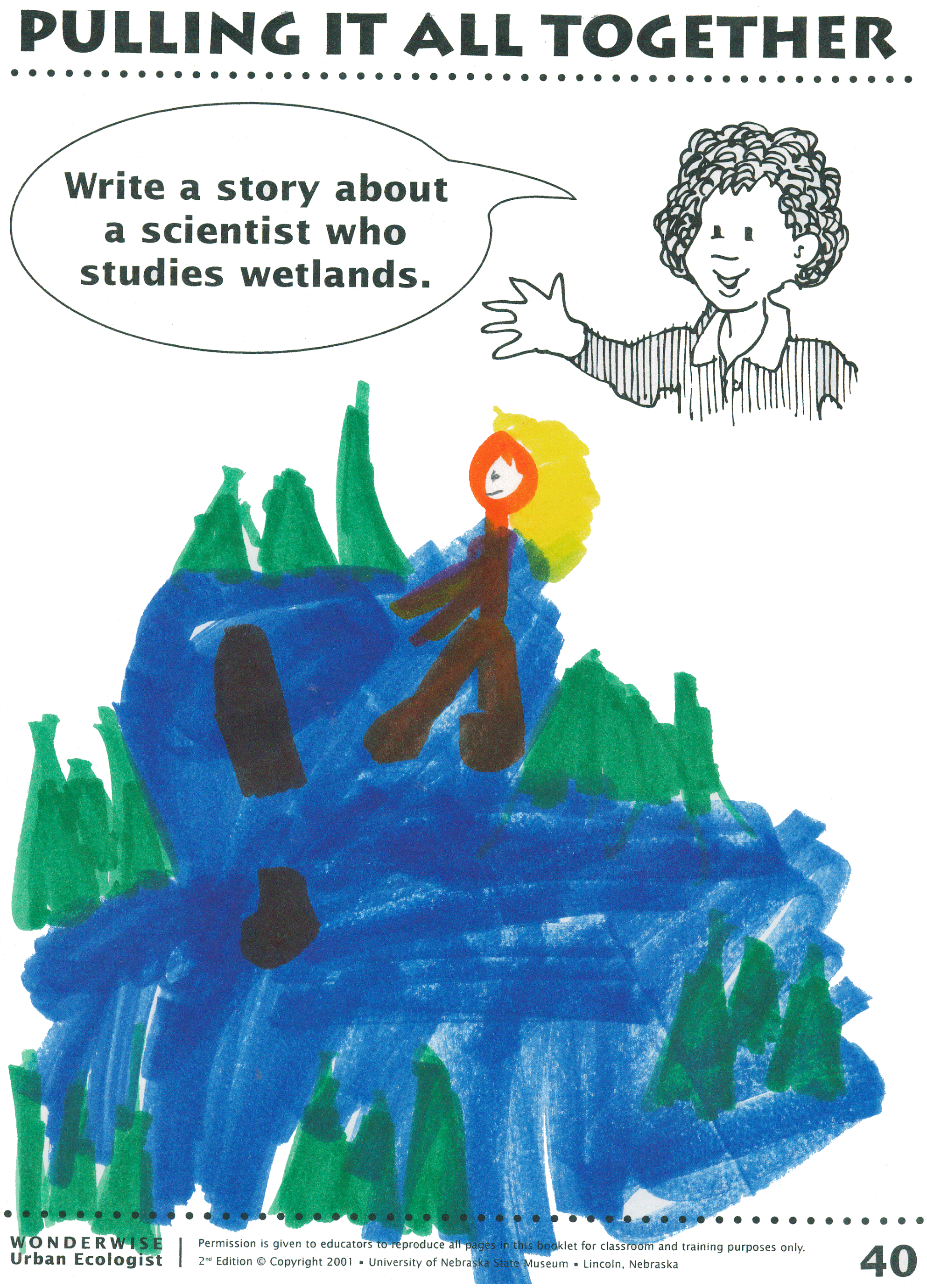

Figure 4.5. Youth Drawing of Scientist in Her Boots

Self-initiated science experiences outside of school. Another youth described cooking experiments they liked trying at home.

> *Like I like to do a lot of experiments, because I find experiments interesting. Like putting like a lot of stuff in a cup and baking it. (African American female, age 11)*

The young woman who won the egg drop contest confessed she like to drop things from her bedroom window to see how gravity worked on different things.

> *And like, that's what I've done at my house. I've dropped stuff out of my bedroom window and like just to see if it would fall. (Caucasian female, age 10)*

A young female talked about her passion for rock collecting. She spoke about her rocks with a conviction.

> *I collect rocks. I have a whole bunch at home. Matter of fact, sometimes I go to Michigan and when I'm at Lake Michigan I take a regular rock I've found and throw it in the sand and if I hear it click than I know that there's a rock there. So I dig it up and take it! I've found fossils before,just little designs in it. I've been running down by the Mississippi, I've found a lot of rocks. I love rocks! If somebody asked me to trade a doll, a Barbie Doll for rocks. I would definitely! (African American female, age 9)*

Influences of Wonderwise

Several individual participants commented on their surprise that they could actually see the scientist doing their work. The individuals were not expecting to see scientists actively seeking knowledge.

> *I have never seen a video of someone really actually found part of something that crashed into the earth or something. (Caucasian female, age 10)*

> *I didn't think we'd get to watch her like at work. Like going to find animals I didn't think we'd get to see that. I thought she would be working in the lab the whole time….like looking at blood samples and bacteria and stuff like that. (Caucasian female, age 10)*

Another participant discussed what she learned because it was a scientist doing her work. Not just someone telling us about it.

> *I liked it because they actually brought you inside sometimes when you watch movies that other people…show it just…they sit down in a*

> *chair and tell you the story. I like it because she actually showed you around and I didn't know they used pollen in trees. I think she taught me a lot of stuff. I didn't know that was pollen in soil and putty and stuff like that. When she said if someone measures pollen I think of lowers and that's all! But now I know that people actually study these things and they actually put their best work into it. I thought it was something scientists would just measure around where they actually find it and they went back to what they were working on before. (African American female, age 9)*

Many of the youth interviewed displayed or connected new learning to existing knowledge. These youth developed theories and conclusions combining existing knowledge and their new experiences. Theories and speculation varied from each kit. Kits observed included *Urban Ecologist, Space Geologist, Vet Detective, Pollen Detective*, and *Rainforest Ecologist*. Other individuals talked about information they gained doing the activities.

Urban Ecologist

After completing the water activities in the *Urban Ecologist* kit one individual commented:

> *I learned that what you do with one thing might affect another person somehow. Like…say you throw away some garbage well…it means extra clean-up for another person. (Caucasian female, age 10)*

During the interview another subject commented that she learned that individuals came from all over the world to study.

> *I think I learned that it takes a lot of work to become who they are. And I learned that people can come from all over the world just to study something. (Caucasian female, age 10)*

Additionally, she commented that it surprised her that mud could be used as evidence and that the wetlands are important to everyone. We can't live without them.

> *I didn't know it(mud) could be evidence. I thought it was just plain mud. (Caucasian female, age 10)*

Pollen Detective

After counting pollen in the sand cookie activity from *Pollen Detective,* an individual commented again on the process of doing science similar to Peg Bollen.

> *They counted the grains. I thought they'd look at it. To see how many is in it. To get like a figure of what most flowers would have in it. So that they get the most out of the pollen that they can get for learning and stuff. (African American female, age 9)*

Space Geologist

A youth involved with the *Space Geologist* kit was able to describe all the earth's layers for his small group .He applied this knowledge to the core sample activity using different sugars to direct a layering effect similar to the real earth's layers. He explains as follows:

> *I knew some of the rock layers like well, that's how we got them in the right order, cuz I knew them. Cuz usually you use the reds like molten lave and then I knew there's a brown layer about that. And then there was limestone between and then there's a fossil layer and then we thought the green was grass, but it was that metal. I've heard of that metal before. (Caucasian male, age10)*

During a simulated meteor dropping activity from the same kit another youth described doubts about real proof a meteor had indeed hit the earth. He based these doubts on the video portion of the *Space Geologist* kit. The scientist in the video did not found the whole meteor.

> *The video, I'm not sure but, I say that they really kind of don't know if the meteor crashed into the earth. But the evidence was pretty good that it might have. They found pieces of maybe a meteor or comet. Or maybe even that huge boulder might have been half of it or something. (Hispanic female, age 10)*

After this activity, another youth asked questions about the meteors which hit the earth based on the experience, where his rock meteor bounced out of the container used to simulate the earth's surface. This youth speculated that meteors might have hit the earth and then moved based on how hard they hit.

> *It was kind of weird that the asteroid, the rock jumped out. So I think Maybe when there was asteroids it maybe hit the ground and did move.(Caucasian male, age 10)*

Others speculated on how hard the meteors hit the earth based on how far they fell. The hands on inquiry-based methodologies used in the *Wonderwise* kits also amazed the youth. After working on simulated asteroid drop activities a youth commented:

> *It surprised me that we were actually …kind of making comets. (Caucasian male, age 10)*

Vet Detective

Discussions were rich and based on experiences and problem solving processes. During the *Vet Detective* kit, after completing a random sampling activity, one individual speculated why elk in the northern herd were dieing from brucellosis at a greater rate then the elk in the southern herd. Although adults present had told her that her theory was not correct, she shared it with an interviewer. The individual whispered to the interviewer not to tell anyone but that she thought this was what going on.

> *In the north, it's cold and in the south, it's hot so their bodies are made different. But they told us that really it's because the southern eats hay and hay has disease in it. (Caucasian female, age 9)*

Additionally, this same female commented on the fact that this activity surprised her because of the sampling.

> *I like how we cut our elk and tried to figure out which one had the most disease. Well I liked it because it was cool how you could just*

> *do a sample and it could tell the truth how it really is. (Caucasian female, age 9)*

Another female speculated on this same activity in this manner.

> *It was weird how like one group was way more extinct that the other or diseased. Probably cuz I think that if you are being fed, you would be healthier because you were being fed, but the ones that had to find their own food, they were actually getting less disease. (Caucasian female, age 11)*

In the video from Vet Detective, Tolani, the scientist is videotaped while collecting manure samples for testing in her lab. This sampling activity drew speculation.

> *Touching poop! I don't know. (Laughs) I thought it was weird. I didn't know she would touch poop! (Native American male, age 10)*

Others questioned the usefulness of poop.

> *She picked up that poop. (laughs) I didn't know you used that stuff. (Native American male, age 11)*
>
> *Well I think I was interesting even though it was gross how they could identify things if the cow had disease by examining of the poop! (Caucasian female, age 11)*
>
> *It was kind of weird actually cuz they took it (poop) to the lab and they are like looking in the microscope and there's (giggles) like little parasites in it. (African American female, age 11)*

One Native American male connected with cultural similarities between himself and Tolani. He wrote about it in his story (i.e., PIAT). He used Native American style story telling to explain what he knew about the veterinarian (Figure 4.6).

PULLING IT ALL TOGETHER

There once A Doctor how lived in Peoter Rico
She was the best one of all She know what
to do but the other Doctor were mad
but the was the wors of all a cyote
was, badk dises how gave it to ther
aml the doctor chri'e
becucs the cyote where like
Thire leodder they had a chace
but to give it ot the best doctor
She cried him And all the other
docter like her but than
She was never some belwe
She was a spirt some people
thoht she died

WONDERWISE Vet Detective | Permission is given to educators to reproduce all pages in this booklet for classroom and training purposes only. 1st Edition © Copyright 2002 • University of Nebraska State Museum and Nebraska 4-H • Lincoln, Nebraska 44

Figure 4.6. Youth Story Depicting Native American Story Telling

He read his story and added additional information during the interview.

> *There once was a doctor who lived in Puerto Rico. She was the best of all. She knew what to do but the other doctors were mad and jealous. But there was the worst of all coyote was badly diseased. How did give to others? They couldn't do anything about it. The doctor cry because coyote were like their leaders. They had choice, they had no choice but to give it to the best doctor. She cared for him over and the other doctors liked her. But then she was never seen again. Some say she was a spirit. Some people thought she died. Anyway that's the end….There was a vet named Susan.. Susan was a nice doctor. She was the best of them all. And all those other doctors were jealous and mad cuz they want to be just like her. And then one day after she fixed the coyote, cuz they obey the coyote and then just then, one day she disappeared. She killed then others say she was a spirit that helped them. And some say she was dead. (Native American male, age 11)*

African Plant Explorer

During the interview another subject commented that she learned that individuals came from all over the world to study.

> *She works with all different kinds of people around the world. (Hispanic female, age 11)*

A second subject commented about the importance of knowledge about scientific careers.

> *The scientist is important to know about. (Hispanic female, age 9)*

After completing a cassava experience, youth created African symbols painted in cassava gel on cloth. Each symbol contained its meaning and country of origination. The cloth was then dried in the sun and dyed to create batik cloth, similar to cloth worn by individuals within the *African Plant Explorer* video. A youth commented on the process and what she learned.

> *We did symbols of other states and countries. Mine was of, it's kind of weird to say. Starts with a C and H-A-N-A. Think it's Changa or something like that…And on paper, that they gave us I found, me and my sister found this cool one, it was the sun. And there was, oh and ours, the one that I picked, um, on the bottom in the bottom of the states, it represents the sky which is God…We put them, like, this kind*

> *of gel on it. And, we let it dry out. They we came back after we were done with some activities and games. And, we put them in, we painted them with this stain. I picked the color brown. And so then when we were done doing that coloring all of it. We put them in the water. After the councilors helped us. And then we squirted all the water out so the brown would get a little lighter. Then with a spoon, a plastic spoon we peeled out the goey stuff and then just left them white. Then we hanged them up...*
> *I didn't know there were so many weird names of states. I learned states, I didn't even know existed. (Hispanic female, age 9)*

Youth Perspectives on People Who Do Science

Youth perspectives were gathered during the interview process in a variety of ways. Youth were asked to describe scientists by (a) creating a story or drawing a picture (i.e, the PIAT) about a scientist who did the type of science they had just learned about, and then recounting their story or picture to the interviewer at the beginning of the interview process, (b) sorting cards containing features of individuals based on whether that individual would or would not do science, (c) describing the video of the featured scientist. Additionally, throughout the interview youth described individuals within their own life who did science.

Impressions from Experiences Prior to Wonderwise

A female subject described several individuals within her life who do science. This individual described her favorite uncle as a scientist who does tests on blood, her parents as scuba divers who have explored the Great Barrier Reef in Australia, and a grandmother who volunteers at the local zoo. Grandma had introduced her to the caregiver for the chimps at the local zoo. This young woman had spent time at the zoo with this caregiver. She was interested in becoming a vet or a marine biologist. She talked about how these individuals could help her achieve her goal. Her parents could teach her how to scuba dive. Her uncle could help her get over her thing about blood and grandma had already shown her a career path which would allow her to work with animals.

> *I'd probably have to learn how to put on gear. Like to stay under water for a while. It's really heavy and I think that would be hard. I don't know where I would learn that, I just figured my parents, they've been diving like a couple of times in Australia near the Great Barrier Reef. So I figured they could probably tell me how. … I've got this thing about blood. I'd probably have to get over that. … My uncle he just kind of works in a lab and studies blood samples and bacteria and stuff like that. He's my blood person. (Caucasian female, age 10)*

Other subjects talked about teachers who made science fun. Teachers who let us do science. One subject described her teacher this way;

> *My science teacher was (name) and she let us experience a lot of stuff. She let us have fun. She didn't let science be boring. She let it be fun. (Hispanic female, age 9)*

> *My science teacher at my school does a lot of neat things. We get to work with things like magnets and stuff, like battery, and how to make a battery work. (Hispanic female, age 10)*

Parents who were nurses, teachers, chemists and interested in topics such as anatomy, and dinosaurs were talked about. One young woman described her dad like this:

> *I love asking my dad about all parts of the human body. I would not like to do that for a living, but to know it for the future. We went to a hospital there's a skeleton and um, it was so funny. He was just messing around and the head fell off. (Caucasian female, age 9)*

A youth described her mom's interest in archeology in this manner.

> *If I had to pick a second job I'd pick archeologist. Well, my mom she's really interested in that. We have passes at the museum and a lot of that is there. I just kind of like it. (Caucasian female, age 11)*

Impressions as Described Through a Story about the Wonderwise Scientist

Youth created a story (i.e., the PIAT) about the featured *Wonderwise* scientist. Youth created central characters within these stories. These stories were analyzed based on primary characters. Female youth drew female characters 82% of the time. Males drew male characters 75% of the time. Several characters were animals or stick type figures where the gender was not identifiable (Table 4.4).

Table 4.4. Central Characters in Written Stories and/or Drawings (PIATs)

Gender of Study Subjects	**Total**	**Male Characters**	**Female Characters**	**Not identifiable by gender**
Male	8	75%	12.5%	12.5%
Female	17	6%	82%	12%
Total	25			

Youth listed many kinds of equipment as part of being a scientist. Lists included: computers, pick-ups, picks and hammers, brushes, microscopes, magnifying glasses, test tubes, labs, chemicals, explosives, tranquilizer guns, syringes, tape recorders and paper for note taking, science books, and college degrees. Youth seemed to focus in on tools. Tools were represented in interviews about what a scientist does as well as richly represented in the drawings done about scientists (Figure 4.7 – 4.9).

Figure 4.7. Youth Drawing Depicting a Scientist Using a Video Camera

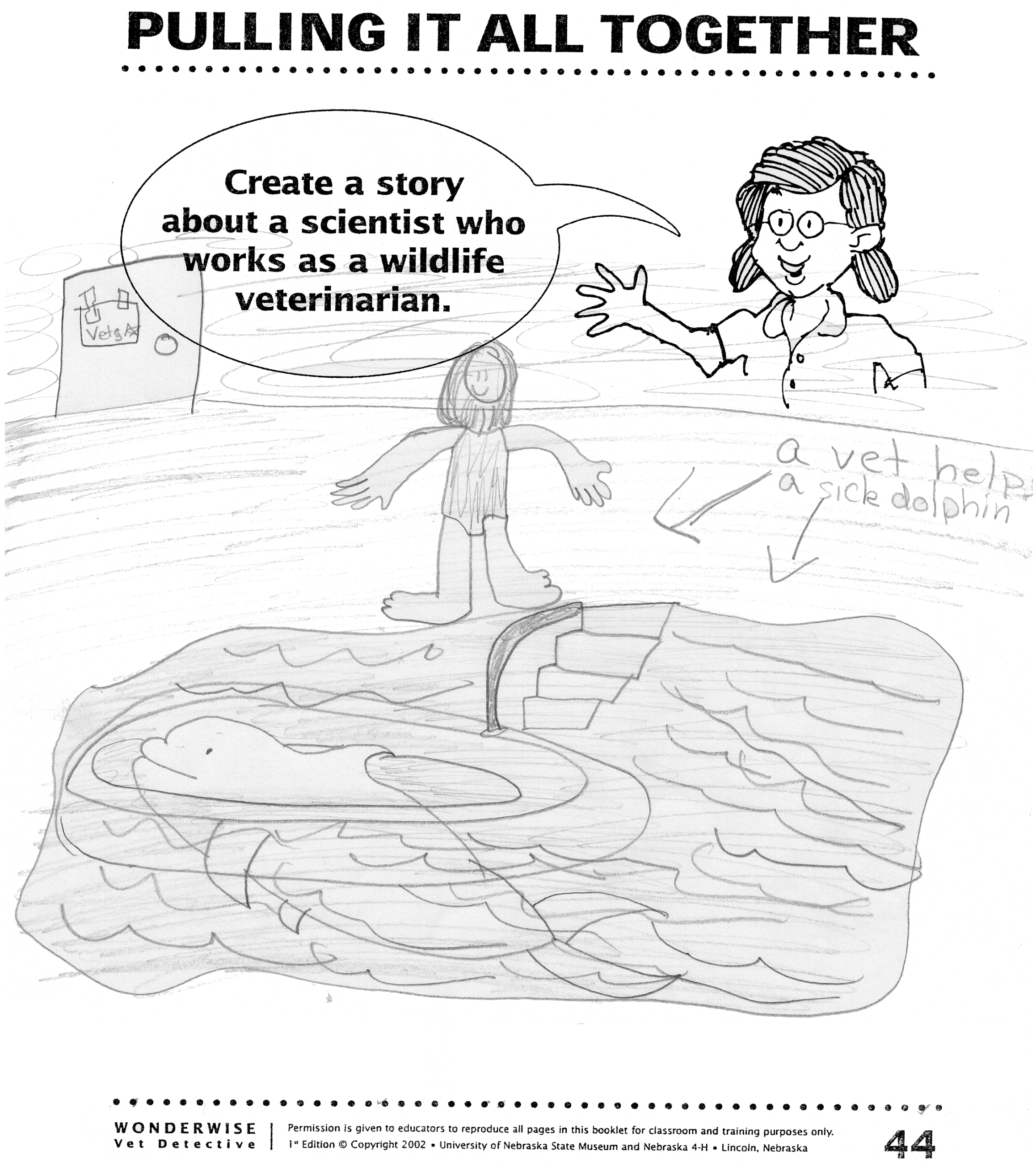

Figure 4.8. Youth Story of Veterinarian Working in a Pool with a Dolphin

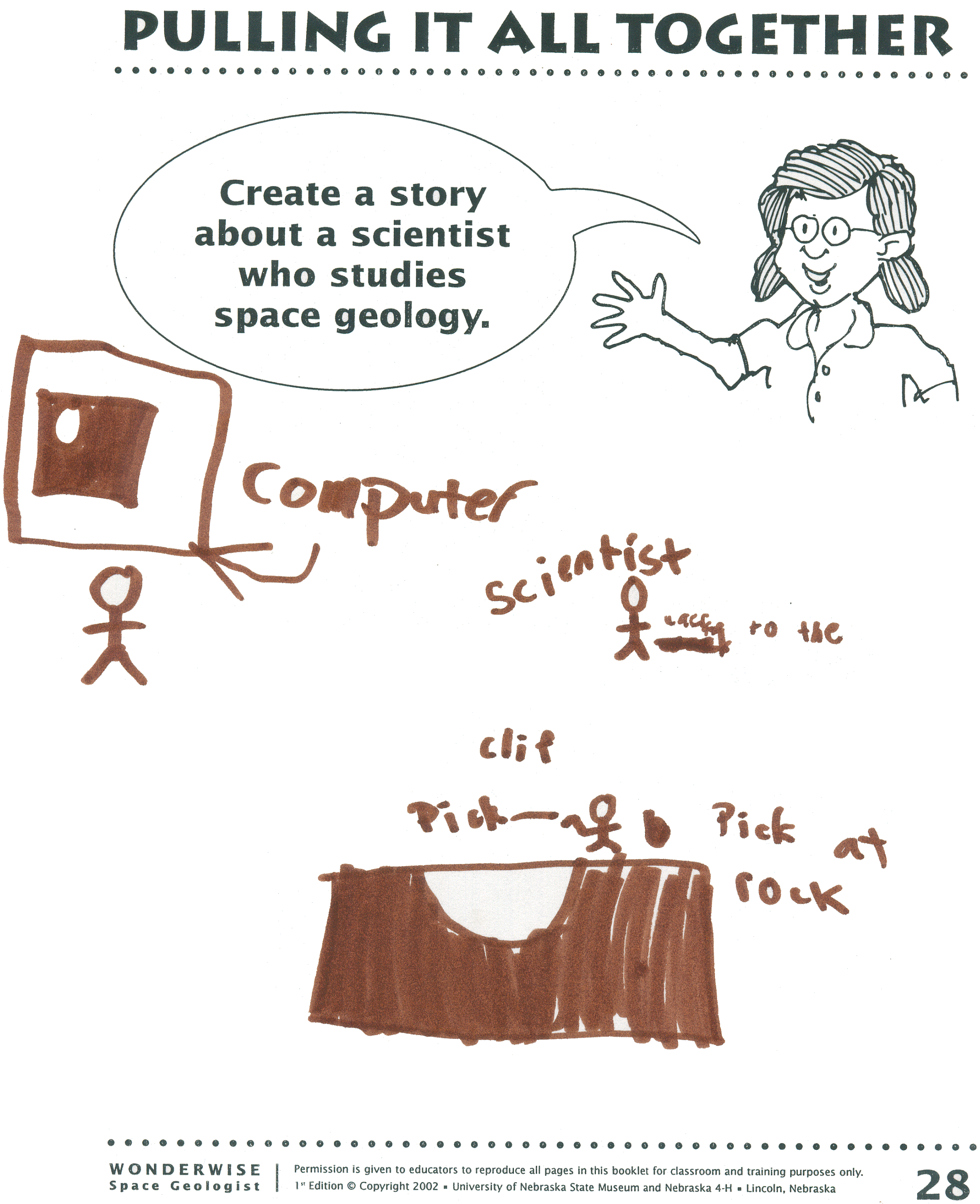

Figure 4.9. Youth Drawing of a Scientist Working with a Computer and Hand Tools

Youth described and drew scientists doing many different work related tasks. Scientists were described as someone who does stuff others think is gross. Scientists were also described as someone who studies, makes predictions, does research, and experiments. Youth talked about scientists collecting samples of rocks, plants, blood, poop, fossils, dinosaur bones and pollen. Scientists were seen as individuals who travel. Youth named travel all over the world including big cities, China, South America, Africa, and Asia. The role of a scientist was described as taking care of or helping people, animals, the environment, plants and wetlands. Youth described a scientist's role as someone who protects endangered species. These individuals explored rainforests and wetlands. Youth often talked of scientists making discoveries that make them famous or rich. Sometimes this discovery was a new medicine or medical procedure. Sometimes this discovery was an invention such as a solar powered car.

Impressions as Described through a "Card Sort" Activity

Youth described scientists based on a card sorting activity. The children selected cards which described individuals who do science. The cards included options such as; is a man, is a woman, is fun, is not fun, is interesting, is boring, works outside, works inside, has kids, has no kids, likes work or doesn't like work. Youth selected these cards based on their own previous experiences and after experiencing a *Wonderwise* video and at least one hands on activity. All of the youth stated that science was not boring; 72% selected scientist as is a man or is women with children; 88% selected that science is interesting; 84% selected that a scientist works outside; 68% said a scientist worked inside; 92% believed a scientist likes their work (Table 4.5).

Table 4.5 Themes that Emerge from the Card Sort

Card set 1	**Selected both**	**Selected neither**	**Selected only "is a woman"**	**Selected only "is a man"**
Gender	64 %	20%	8%	8%
Card set 2	**Selected both**	**Selected neither**	**Selected only "likes work"**	**Selected only "does not like work"**
Attitudes about work	0%	24%	76%	0%
Card set 3	**Selected both**	**Selected neither**	**Selected only "is fun"**	**Selected only "is not fun"**
Enjoyment level	0%	24%	76%	0%
Card set 4	**Selected both**	**Selected neither**	**Selected only "is interesting"**	**Selected only "is boring"**
Interest level	0%	12%	88%	0%
Card set 5	**Selected both**	**Selected neither**	**Selected only "works outside"**	**Selected only "works inside"**
Work environment	60%	8%	24%	8%
Card set 6	**Selected both**	**Selected neither**	**Selected only "has kids"**	**Selected only "has no kids"**
Family	24%	24%	48%	4%

There were several individuals whose answers stood out as unusual. One individual pointed out that scientist don't like regular work so they do science. This was the only card he selected.

> *They don't like regular work, but they like science work. (Caucasian male, age 10)*

Others chose to completely ignore the gender cards stating that they don't matter because a scientist can be either a man or a woman. Several individuals commented that scientist would have children so they could work with them and teach them science.

> *Well, you could show your kids and you could do activities with them. (Caucasian female, age 9)*

One individual told us that scientist would have children so it wouldn't be boring.

> *Has kids, unless you want to be bored. He or she could have a kid and a husband or wife. (Hispanic male, age 9)*

Several rationalized why people who do science like work or their work was interesting.

> *If they didn't like work they probably wouldn't do it. They're probably interesting to some people. (Caucasian male, age 10)*

When prompted by the interviewer if he found them interesting he replied:

> *Yeah! Sometimes there's chemistry. I think that would be interesting. And pretty much the work they do sometimes. (Caucasian male, age 10)*

Others shared differing views for why the work could be interesting.

> *Is interesting. Because, it's like they could do like corn and stuff, like they dissected a cat or something. I could be interesting. (Hispanic female, age 10)*

Several individuals shared with us that people who do science like their work.

> *If you were a scientist and you didn't like work why would you even think to be a scientist? (Caucasian female, age 10)*
>
> *Cuz in science you could do lots of kinds of work and they could be very interesting. (Native American female, age 10)*
>
> *And then likes work. And then you'd like work cuz you get to invent stuff. And you're always doing something, you're just not sitting around being bored. They invent, they study, they talk to kids about stuff. (Caucasian male, age 9)*

Role Models

Offering youth the opportunity to see female scientist as role models is one of the primary goals of the *Wonderwise* curriculum. Through the use of the semi-structured interviews and the relationship maps, individual views of how scientists fit into these youth's lives were noted. Some of the children had on-going relationships with individuals who were important role models within their lives. Analysis of interview transcripts and maps illustrated different levels of relationships between these youth and the *Wonderwise* scientist.

Youth were asked to draw a relationship map similar to a solar system diagram. They were to place themselves in the center of the map like the sun. They were to place others on the map who were important in their lives. Individuals close to them were to be closer to the center. Individuals who were less important or not as close were to be placed farther out. In several instances individuals placed the *Wonderwise* scientist on top of themselves or very close to self. The star on each map represents someone you most want to be like when you grow up.

Descriptions of People in Youth's Relationship Network

The individuals starred (*) on each relationship map varied among individual subjects. Two individuals starred more than one person on their map. The top four role models discussed by subjects were family members. Females selected a family member or friend at a rate of 90%, 68% of males selected family or friends. Additionally, females chose female role models 73% of the time. Two males told us they had never meet an individual who served as someone they would like to be like.

Additional role models mentioned included teachers, scientists, sports figures, and a veterinarian (Table 4.6).

Table 4.6. Role Models in Youth's Relationship Networks as Described on Relationship Maps

Person most like to be like	Total Reponses	Male Subjects % (n=8)	Female Subjects % (n=17)
Mom	7	0%	41%
Dad	3	25%	6%
Female Relative	3	0%	18%
Male Relative	3	13%	12%
Friend	3	0%	18%
No One	2	25%	0%
Scientist	3	13%	12%
Teacher	1	0%	6%
Veterinarian	1	13%	0%
Sports Figure	1	13%	0%
Total	27*		

*On two of the maps the subject selected two people as role models.

Youth attributed several different characteristics to role models listed above. One of the youth who had marked a friend as the person she most wanted to be like explained her map in this manner:

> *Her name is (name). She may be older than me, but she cracks me up! (Caucasian female, age10)*

Another described her mom's friend, who also was a lawyer. The girl choose lawyer as she described her career vision.

> *She's my mom's friend. She's a very special person. Everybody knows her. Well, not everybody but a lot of people know her. She helps me when I have a problem. (Hispanic female, age 10)*

A Mom was described in the following manner.

> *My mom…She's important to me cuz she helps me, and she trusted me, and I trust her. And she's not mean! (Hispanic female, age 9)*

A Dad was described as:

> *My Dad, because he plays basketball. (African American male, age 10)*

Two uncles were described by two different females as:

> *My uncle, he's has a really, really good sense of humor. (Hispanic female, age 10)*
>
> *He's my dad's brother, cuz my dad's the oldest of five kids and he was, name, was youngest, and he has always been my favorite uncle. 'Cuz he's really nice and really cool. (Caucasian female, 10)*

Placement of the Wonderwise Scientist within the Relationship Maps

Youth placed the *Wonderwise* scientist in a variety of places on their maps. Only female subjects placed the female *Wonderwise* scientist on top or next to self on the relationship map. One female placed the scientist next to the individual she most wanted to be like (* individual) on her map. Females were more likely than their male counterparts to place the *Wonderwise* scientist within their relationship map (Table 4.7).

Table 4.7. *Wonderwise* Scientist as Placed on the Relationship Maps

Map Description Places *Wonderwise* Scientist …	**Total**	**Male Subjects %(n=8)**	**Female Subjects %(n=17)**
…on or near self	5	0%	29%
…on or near * individual	1	0%	3%
…within relationship network	10	50%	35%
…outside of relationship network	9	50%	29%
Total	25		

Figure 4.10. Relationship Map Depicting Tolani Next to the Individual

The individual who drew the map in Figure 4.10 talked throughout her interview about being a veterinarian or a marine biologist. This is the explanation she gave for her map.

> *She's kind of close to me cuz she's like an animal person and I like animals too. (female, age11)*

Figure 4.11. Relationship Map Depicting Tolani Next to the Individual

The individual who drew the map in Figure 4.11 repeatedly stressed in her interview that she wanted to be a veterinarian. This is the explanation given for her map.

> *I put Tolani beside me. Because I am a wildlife person… because I want to be…well not so much wild life but animal life. Like animals that maybe can come from the wildlife, but not all wildlife. (African American female, age 11)*

In several instances individuals placed the *Wonderwise* scientist next to or close to the person they most want to be like (starred individual).

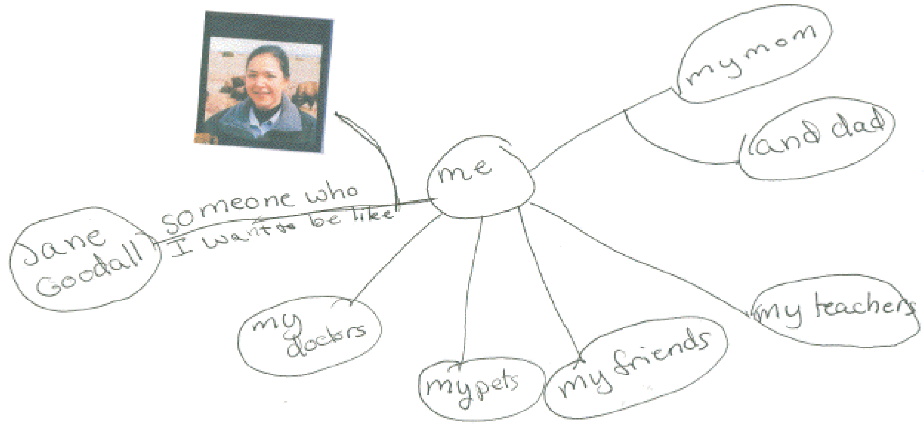

Figure 4.12 Relationship Map with Tolani Near the Starred (*) Individual

The individual who drew the map in Figure 4.12 also placed Jane Goodall on her map as someone she most wanted to be like when she grew up. She placed Tolani between herself and Jane Goodall. This is her explanation given for her map.

> *When I grow up I want to be like Jane Goodall because she studies monkeys, chimpanzees. And she helps animals. And I want to be like Tolani because she's a vet. (Caucasian female, age 9)*

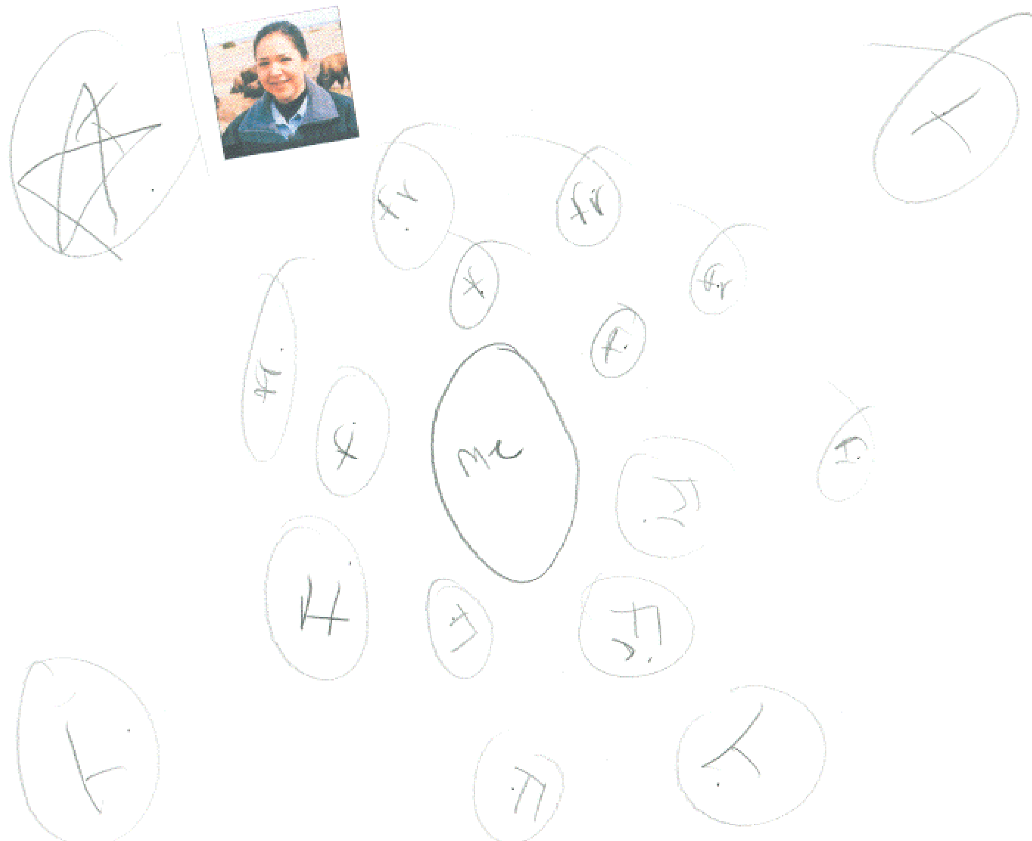

Figure 4.13. Relationship Map Depicting Tolani Near the Starred (*) Individual

Within the map in Figure 4.13 F stands for family, and FR for friend. This is the explanation given by subject who drew this map.

> *I put my star on one of my teachers, (name). That's a scientist who loves animals. She taught me a lot and…she taught me how to do essay mostly. She told me…she mostly gave me a good college to go to…UNL because she went there and I think that might be the reason why I want to go. When asked where she would put Tolani, the subject said by my teacher. (Caucasian female, age11)*

Figure 4.14. Relationship Map Depicting *Wonderwise* Scientist Near Other Individuals on the Map

This is the explanation given by subject who drew the map in Figure 4.14.

> *If I knew her she would be right in between, right a little bit, near my future family is and where my cousin is, because she's taught me things and I think that's really cool for her! She's shared things with other people, who she really doesn't know. Peg, it seems like is a nice girl. I would really like to meet her if I could. (African American female, age 9)*

Finally, some subjects placed the scientist further away from self and other significant individuals on their maps. This subject placed Adrianna Compos near her sister.

Figure 4.15. Relationship Map Depicting *Wonderwise* Scientist on the Outer Edge of the Map

This is the explanation given by the subject who drew the map in Figure 4.15.

> *I don't know her but I think she would go right down there. (Hispanic female, age 10)*

When prompted for further information about what made Adrianna similar to individuals in her drawing she replied:

> *She's probably like my sister. She studies a lot and likes to do science work. (Hispanic female, age 10)*

When prompted to explain how Adrianna was different. She replied.

> *I've never met her. (Hispanic female, age 10)*

The next type of relationship map displayed the *Wonderwise* scientist on the outside of the map. The scientist in this kind of relationship map was distanced from other individuals on the map.

Figure 4.16. Relationship Map Depicting *Wonderwise* Scientist on Outside of Map

This individual placed Tolani on the outside edge of her map. This is the explanation given by the subject for Figure 4.16.

Because I don't know her. (Native American female, age 9)

Figure 4.17. Relationship Map Depicting *Wonderwise* Scientist on the Outer Edge of the Map

The male placed the sticker halfway between edge of paper and his cluster of individuals on his map (Figure 4.17). He explained.

> *Halfway close. Halfway far. She's halfway close to me because she helps to tell me like what plants and stuff to stay away from. And she is a little bit far form me because I don't really hear from her much. (Hispanic male, age 9)*

Another individual placed Carmen Cid, the scientist in *Urban Ecologist* out on the edge of her map. She placed Carmen between the edge of her paper and near her teacher.

> *By my teacher. She's not very important to me cuz I don't really know her she's important to everybody else because she picks up the wetlands and studies everything. And scientists are mostly important to people. And my teacher is kind of like that. I mean she's important to me and she's kind of like about the same as important to me than Carmen is. (Caucasian female, age 9)*

Two individuals did not star anyone on their maps. In both cases the subjects placed the *Wonderwise* scientist on their maps and gave explanations about role models (Figure 4.18 – 4.19).

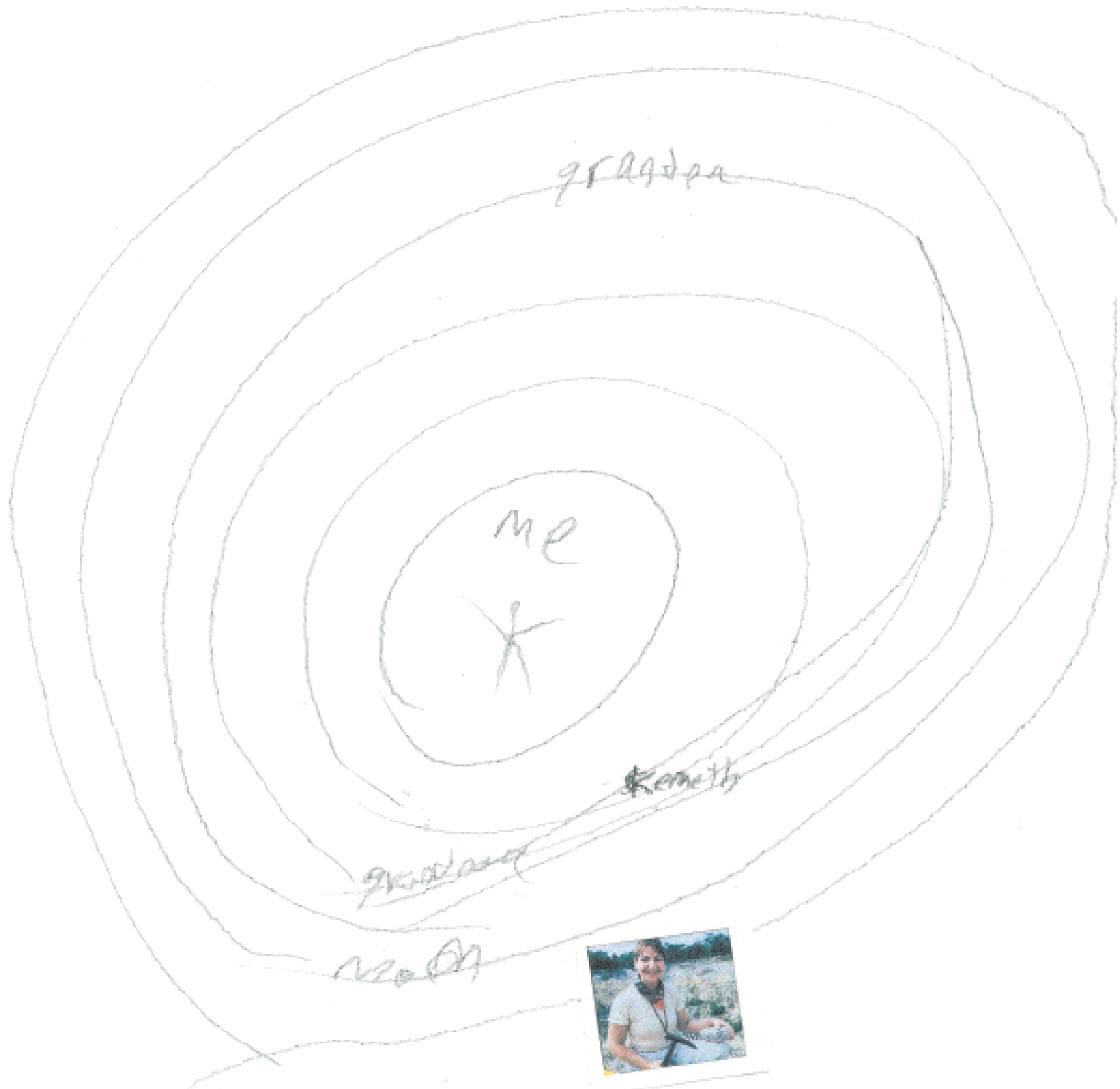

Figure 4.18. Relationship Map Depicting no Starred (*) Individual and *Wonderwise* Scientist on the Map

A male youth from a rural area told us he had never met anyone he wanted to be like. He couldn't place a star on his relationship map (Figure 4.18). When given the sticker of Adrianna Campos, the geologist in *Space Geologist* he said:

> *I think I might also be kind of cool to be also what she's studying and everything. That might be kind of cool to be too. Well I mean I might like to be one. (Caucasian male, age 10)*

Figure 4.19. Relationship Map Depicting no Starred (*) Individual and *Wonderwise* Scientist on the Map

Another male subject placed Tolani on his relationship map in the middle between family and other people (Figure 4.19). He explained that there wasn't really anyone he would like to be like when he grows up. So his map also contains no star. He explained his map as follows:

> *Probably in the middle. I'll just put her right there. She was a really good person, she's fun, and she's a role model. (Native American male, age10)*

Cultural Implications

Several youth gave cultural explanations for the placement of the *Wonderwise* Scientist on their maps. These individuals still placed the scientist on their map but explained the scientist's placement based on similarity or dissimilarity of culture.

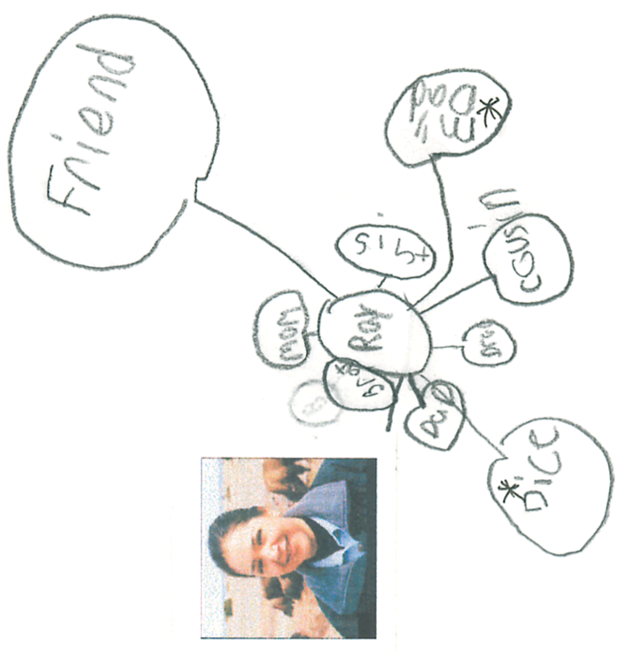

Figure 4.20. Relationship Map Depicting Cultural Placement

The male that drew the map in Figure 4.20 explained Tolani's placement based on a similar culture.

> *She was a scientist. She's good at protecting animals and some people say she's cute. She's now in the army. She's part of my culture. Cuz, I'm Winnebago and she's Seguna. (Native American male, age 11)*

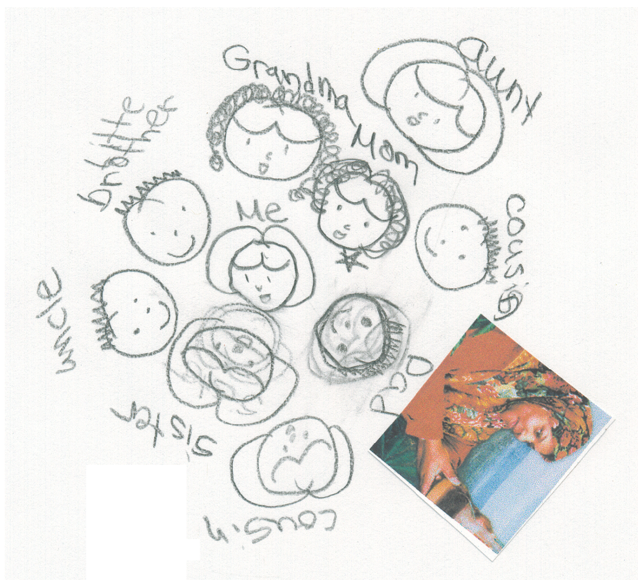

Figure 4. 21. Relationship Map Depicting Cultural Placement.

Placement of Fatimah from *African Plant Explorer* in the map in Figure 4.21 was because the young woman felt that Fatimah was from another country and culture. This is the explanation given.

> *From a different culture. From a different country too. (Hispanic female, age 9)*

Career Visions

As a part of the interview process youth were asked what they wanted to be when they grew up. Individual responses were clustered into two groupings science related and non-science related. At times individuals stated several options they might like to be. Sometimes these options seemed at opposite ends of the career continuum. Probes were asked about why individuals chose this career. Answers illustrate the depth of thinking of the individuals interviewed.

Non-Science Related Careers Mentioned by Subjects

Non-science careers were careers in which science is not the primary function of the job. Careers mentioned by youth included teachers, lawyer, singer, professional sports, construction work and ranching. Individuals provided differing reasons for career choices (Table 4.8).

Table 4.8. Non-Science Related Career Choices

Non-Science related careers	Number of responses by males	Number of responses by females
Elementary Education / Early Childhood Teacher	1	4
Lawyer	0	1
Singer	0	2
Basketball Player	1	1
Football Player	2	0
Musher	1	0
Dirt Bike Racer	1	0
Construction Worker	1	0
Rancher	0	1

Individuals who selected non-science related careers described them as follows. A young woman described her desire to be a childcare teacher in this manner.

> *Well I think I would like to do a daycare. I think children are our future.That's what gives everyone who they are. I read a lot of books. They say that children develop. I pass the daycare all the time when I go to Kim's all the equipment is out there and I'm pretty sure there's a lot of kidsWho go there and they probably need a lot more help. (Caucasian female, age 10)*

When prompted by the interviewer what she would need to learn she replied:

> *What children like. You gotta learn what the person is like. The kid could be really nice or really mean inside. You can't judge people by their appearances, but by their insides once you get to know them. (Caucasian female, age 10)*

A male talked about a cousin who had gotten a job in construction for the summer. He described his future goals of being a construction worker in this manner.

> *I want to be a construction worker, like on the streets. Like you get to find out how people get into accidents and what's in the cracks… You need to learn how to use all the tools, like tractors and stuff… I'd like to use explosives. Like there's a whole bunch of houses and stuff. Like they have to close the road and like you can explode the whole road and make another one and like never have no holes or cracks. (Hispanic male, age 9)*

A female girl described her future as a rancher as:

> *I'd like to stay on a ranch. I kind of like to doing boys work better than doing my mom's work. (Caucasian female, age10)*

Science Related Career Mentioned by Subjects

Science careers were careers in which science is one of the primary functions of the job. Careers mentioned by youth included veterinarian, medical careers, NASA engineer or astronaut, science teachers, marine biologist, archeologist, and geophysists (Table 4.9).

Table 4.9. Science Related Career Choices

Science related Careers	Number of responses by males	Number of responses by females
Veterinarian	2	6
Invent Medicine	2	1
Nurse	0	2
Doctor	1	1
Physical Therapist	0	1
NASA Engineer/Astronaut	2	2
Science Teacher	0	3
Scientist	2	2
Marine Biologist	0	2
Geologist	0	3
Archeologist	0	1
Geophysist	0	1

One Native American male from a poverty stricken rural area described himself as wanting to be a scientist who does lots of experiments. When probed to describe his experiments he replied:

> *How you can figure out dust…how to get rid of weeds….and diabetes try to get rid of that. Try to cure it. Keep experiments and stuff…and they try to keep the money at low prices so other kids and people can afford like 20 or 10 bucks maybe 15. (Native American male, age11)*

A female wrote her PIAT story about being a veterinarian. She described herself as someone who isn't afraid to touch animals and plans to go to college as long as it takes until she is a vet. Her story is as follows:

> *Hi my name is veterinarian (own name) and I explore the wild life. I also take in hurt animals until they are better, I let them back in the wild. I examine and take in to fix all kinds of animals from the wildlife. By me helping these animals it decreases the extinction of wildlife. I am sort of like a veterinarian in an animal hospital except I take the animals from wild. I really enjoy what I do because I like all the*

> *animals and because I know I am helping them. That is my job as a veterinarian. (African American female, age 11)*

A male from a rural area described his desire to be a NASA engineer. When asked about his career choice he relied:

> *I want to help NASA build rockets…kind of an astronomer. I want to design them and build them. I want to work on engines. I'd study aerodynamics. (Caucasian male, age 10)*

Self Belief and Career Choice

One young woman was observed all week. She made little to no eye contact with anyone. She tended to stay off on her own. She was quiet and seemed reserved. Her written story (PIAT) was a thank you note to the program she attended using the *Wonderwise* curriculum.

> *Hi my name is (child's name) and I'm going to share my story with you. I heard about a vet that helps with wild life animals, when I heard I was like shocked cause I didn't think was true. I just thought regular vets so the same thing to wild animals too. I went to vet detectives were been watching movies and this wild life veterinarian I decided to be a wild life veterinarian. So now I thank (Program Name) cause they help and gave me clues to be a veterinarian. (Caucasian female, age 11)*

Chapter V

Discussion

Introduction

This study contributes to understanding how youth participating in a science experiential module (i.e., *Wonderwise* 4-H curriculum) in nonformal educational settings (a) connected to science and scientist role model, and (b) incorporated this subject matter into their own thinking.

The Study's Subjects

The subjects studied in the *Wonderwise* 4-H project were primarily 9-11 year old youth who had some interest in science. They were primarily female. Nearly half were Caucasian; the remainder were Hispanic, African American and Native American. While the gender gap is gradually decreasing, research indicates that at adolescence (i.e., about age 12), females began to loose academic interest in Math and Science (O'Sullivan, et al., 1997). Lee (1998) indicates that females and minorities are usually underrepresented in the areas of Math and Science. Females within this study seemed to be interested in Science.

Impressions about Science

Previous Experiences with Scientific Education and Activities

Youth who are already relating to science seem to see science as experiential and rich in content. Youth described science experiences in formal school settings and outside of school in both nonformal and informal settings. The youth interviewed only discussed experiences "doing" science. Youth gave examples of experiences prior to *Wonderwise* as well as *Wonderwise* activities. Youth described "doing" science as experiential in nature, including activities and experiments where the youth manipulated and explored real objects. Youth never described didactic learning activities such as worksheets, textbook reading or lectures as a manner in which they "did" science. Youth never commented on *Wonderwise* printed materials packets presented to them explaining directions and record keeping for each activity. Youth always discussed the activity or experience of "doing" science.

Contrary to findings in this study, interviews conducted by Brickhouse, Lowrey, and Schultz (2000) cited descriptions of science as boring, easy and memorization of facts. To succeed in science classes youth described "sitting there and listening".

This study supports Greenfield (1997), Baker (1987), and Gurian (2001) who stress a need for inquiry based practices and providing young women with scientific role models at an early age.

People Who Do Science

Youth described people who do science as multidimensional "real" people. Through youth's stories and drawings, scientists were described as people who study, do research, make predictions, invent things, work with a variety of tools and technology, travel and work with all kinds of people from all over the world. Youth further demonstrated their knowledge of scientists as multidimensional "real" individuals during the card sort activity. Youth described people who do science as (a) either a man or a woman with children, (b) like their work, (c) work outside or inside, and (d) are interesting.

The findings of this study were contrary to previous studies by (Kahle, 1989) which found children have very stereotypic views of scientists. The findings of this study seem to support the AAUW (1992) declaration that any contact with scientists and their activities can help girls reduce negative sterotypes about research-based disciplines and begin changing attitudes about science.

Science as a Career

Wonderwise reinforces a desire for a scientific career. Research associates career choice to influences of role models. Youth shared with the research team their own career visions. The youth at times compared career visions to the *Wonderwise* scientist they had just learned about. A female youth stated that after being a part of the *Wonderwise* activities she now knew she could be a wildlife veterinarian. Identification by this individual with the *Wonderwise* activities and scientist seemed to have an impact on this her self concept.

For this individual identification took place within the 4-H *Wonderwise* project. Identification with female scientists was one of the main goals of the *Wonderwise* 4-H grant project. According to Josselson (1996), the very nature by which we value others is by becoming like them through identification. The nature of identification is consciously trying to be like someone we admire. Research has shown an association between career choices and the influence of role models (Anderson, 1995, Ragins, 1997; Perrone, et al., 2002). This study supports researchers belief that contact with prominent female achievers can help girls overcome their lack of interest in science careers (Baker, 1987, Diamond et al., 2000).

Role Models

Important People in the Youth's Relationship Network

Youth within this study identified family members as the individuals they would most like to be like. Youth attributed a variety of characteristics these role models possess including sense of humor, trust, caring, sports abilities, sense of style and helpfulness. The second level of individuals included teachers, and friends. Sports figures placed at the third level. This finding is consistent with role model research for youth. Significant adult role models who are involved in youth's lives are usually found in immediate and extended family (Bryant et al., 2003; Blyth et al., 1978; Hayes et al, 1973; Hendry et al.,1992; Shade, 1983).

The Wonderwise Female Scientist as a Role Model

It appears that a connectedness existed for females within the *Wonderwise* 4-H project. Bandura's (1977) theory speculates that one factor influencing role model effectiveness is based on the similarity of the new role model to the previous role model. The *Wonderwise* scientists were filtered through these individuals when chosen or rejected as possible new role models.

Kahle's (1989) Draw-a-Scientist Test, upon which the youth's stories and drawings (i.e., the PIATs) is loosely associated, found it unusual for children to draw female scientists. Contrary to Kahle's findings within this study, females drew or wrote about female scientist as central characters in 82% of the PIAT stories. Additionally, youth placed themselves as the central character in the story. Youth identified with the central characters, they wanted to be like them, wanted to do their jobs, work with the equipment, travel and become famous.

One of the most common experiences reported by individuals in a vital encounter was a feeling of having your awareness expanded. Individuals within this study talked of family, friends, teachers, and the *Wonderwise* scientist who offered them something of interest and lead them into other experiences. There appeared to be respect for the diversity of experiences the youth with them. Women especially move along through this relatedness connection (Josselson, 1996). Youth described desires to be like the *Wonderwise* scientist.

Females were more likely to place the *Wonderwise* scientist within their relationship network on their relationship maps. Only females placed the *Wonderwise* scientist on top of or next to self on the relationship map. One female placed the *Wonderwise* scientist next to her starred individual on the map. Contact with prominent female scientists was one of the goals of this NSF grant program. This study's findings support Staub's (1978) suggestion that a role model's effectiveness could be based on the degree in which the individual identifies with the role model. Under many conditions research sees same sex role models as more effective for eliciting imitation than opposite sex role models (Bandura et al., 1961; Malcoby et al. 1957; Owens et al., 1991). This appears to be true within this study as well.

Native American youth within this study demonstrated some cultural connectedness with Tolani. The Native American youth seemed to connect with Tolani because of cultural similarity. Youth described being of the buffalo or the buffalo being a part of their clan. The youth also described Tolani as a role model. One youth stated that she had never met a Native American veterinarian before. The significance of this youth meeting someone of a similar cultural identity who shared and interest in veterinary science seemed to tie to this student's need to have role models within her own culture. Such identification ties to the National Science Standard encouraging recognition and response to diversity.

Experiential Learning with Multiple Educational Activities

Nonformal Educational Environments

Youth had opportunities to experience, share, process, generalize and apply new knowledge generated through the *Wonderwise* kits. The National Science Standards encourage youth to have opportunities to use multiple methods and systematically gather data. This appears to have happened within the *Wonderwise* activities. Generalization opportunities happened when ties were formulated between what the featured *Wonderwise* scientist in the video did and the activities the youth had just completed.

Youth developed theories and conclusions combining existing knowledge and new knowledge gained during *Wonderwise* activities. Theories were generated around the elk herd in *Vet Detective* was dieing out faster in one location over the other, how meteors in *Space Geologist* activities hit the earth, and whether the meteors bounced upon hitting the earth. The theory development demonstrates a tie to the National Science Educational standards. Youth were orchestarting discourse amongst their peers about scientific ideas. Youth were challenged to accept and share responsibility for their own learning.

The experiential nature of methodologies used in *Wonderwise* activities seemed to fit into previous learning the youth described. Youth had opportunities to try on new scientific methods through experiences in *Wonderwise*. Through *Wonderwise* activities youth were in a settingwhich was flexible and supportive of science inquiry. Youth described surprise and intrigue at methodologies including random sampling in *Vet Detective*, making models of watersheds in *Urban Ecologist*, and breaking apart sand cookies to reveal pollen counts in *Pollen Detective*. Discussion facilitated by adults within the *Wonderwise* 4-H experiential learning format seemed to encourage on-going discussion by youth on rules of scientific discourse.

The field trip methodology used in the *Wonderwise* video format allowed individuals to personalize the experience. The video field trip format was new for subjects. Subjects described previous video experiences as seeing someone just talk about science. Subjects vocalized surprise at actually seeing scientist seeking, researching and exploring new knowledge. The *Wonderwise* trip format seemed to meet the nation science standard in which models were present to emphasize the skills attitudes and value of scientific inquiry. Additionally, this format encouraged and modeled the skills of scientific inquiry, curiosity and openness to new data, and skeptism that characterizes science.

Informal Educational Experimentation

Youth who were interested in science described informal experimentation with science and science principles. Youth described independent self selected activities such as cooking, dropping things out of bedroom windows and rock collecting. Youth did not always connect these activities as “doing” science. Constructivist-based research suggests that informal science related play and toys lay the foundation for a child's development of science concepts and attitudes about science (Kelly, 1978; Tracy, 1990; Jones, et al., 2000). It appears this experimentation builds science concepts and attitudes.

Chapter VI

Conclusions, Recommendations, and Future Research

Introduction

The purpose of this research was to (a) explore how children participating in an experiential learning module (i.e., *Wonderwise* 4-H curriculum) in nonformal educational settings (a)connected to science and a scientist role model and (b) to better understand if children incorporated the subject matter into their thinking.

The research explored how to the use of *Wonderwise* 4-H kits in a nonformal educational setting affected the ways children think about science and scientists. The specific sub questions addressed were:

1. In what manner did individual children identify with the role models in the *Wonderwise* 4-H kits?
2. How did children use the activities and videos in *Wonderwise* 4-H as they incorporated subject matter into their thinking?
3. What patterns emerged as the children incorporated the subject matter from the 4-H *Wonderwise* kits into their current knowledge?

A multiple method case study approach was used to study 25 youth ages 8-11. They were personally interviewed, drew pictures or wrote stories about their experiences with *Wonderwise*, sorted cards to describe attributes of scientist, and drew a relationship map. By triangulating the results of these four data collection processes, a picture emerged of how using the *Wonderwise* materials in a nonformal setting aaffected the ways children thought about science and scientists. Specifically, it provided an image about these 25 youths' view of science and the people who do science, and their connection with the role models in the Wonderwise curriculum and its effect on their career vision.

Conclusions

Wonderwise 4-H was born of a vision to increase young women's awareness of scientific concepts and increase their interest in scientific exploration to influence their desire to more closely connect with the scientific fields as they pursue career goals. While the vision has been validated by this study, it is too soon to identify the long-term impact on career goals.

Specific conclusions about now the youth in this study viewed science are:

1. Youth participating within this study were already interested in science. These youth signed up for activities organized primarily around science topics. This could be skewing other study findings and making them more pronounced because the sample of youth might have had a higher level of interest in science to start with than most youths within their age bracket.
2. Youths' prior experiences in formal, informal and nonformal settings impacted how they made sense of and incorporated the *Wonderwise* experiences into their frame of reference. Throughout the interview process youth related to these prior experiences as they described how they felt about the science, the scientists, and their career aspirations.

Specific conclusions about how youth in this study viewed people who do science

are:

3. Through the experiential learning process youth experienced science activities and connected to individuals with science backgrounds, particularly those individuals within their relationship networks such as parents, uncles, grandparents, siblings and teachers who "do" science. This exposure to a variety of individuals in the "real" world allowed the youth to see Wonderwise scientists as "real" people versus stereotypical descriptions.

Specific conclusions about *Wonderwise's* use of female scientist as a role model are:

4. Girls within this study related to and identified with the female role models presented in the *Wonderwise* 4-H curriculum. Girls placed the *Wonderwise* scientists on their relationship maps and described wanting to be like specific *Wonderwise* scientists. Females listed individuals within their relationship networks who were similar to the *Wonderwise* scientists.
5. Native American youth within this study related to Tolani based on a similarity in culture. They described manners in which their cultures were similar, even when the tribal ties were different.
6. Youth related to the *Wonderwise* scientist because of the role models already within their relationship networks. Youth viewed the *Wonderwise* scientists as similar to these individuals and saw them as people they would like to be like.

Specific conclusions about the association between career choice and the influence of role models in the *Wonderwise* 4-H curriculum are:

7. *Wonderwise* activities reinforced the desire to choose a scientific career, specifically in the young girls. They identified with the scientific role models and hands on experiential learning activities which nurtured increased self confidence in youth's own ability to do science as a career.

National Science Standards set the benchmarks for quality science curriculums. *Wonderwise* 4-H identified programming goals based on these standards.

8. *Wonderwise* curriculum supports National Science Standards . Youth were involved and participated in inquiry based science processes throughout the experiential learning activities within each curriculum kits used in the test sites. Youth were challenged to support their own learning using inquiry based practices and were able to articulate how the designed activities were integrated into their conceptual thinking processes.
9. Youth participating in each of the Wonderwise curriculum kits connected to the scientific subject matter which included contained topics on earth and space science, science in personal and social perspectives, life science, physical science, unifying concepts and processes, and science as inquiry. These topics care identified in the National Science Standards.

Recommendations

Specific recommendations about curriculum design, implementation and impact on youth's view of science and scientists are:

1. Science curriculum for both formal and nonformal education needs to be designed based on the "doing" of science. Based on a experiential

learning model, science theory needs to be integrated into activities where youth experience how science works.

2. Curriculum needs to include activities for nonformal and informal learning environments. Examples of science experiences that can be done by youth on their own or with an adult need to be included within curriculum design. These experiences could include experiments or information on additional resources such as web sites, museums, or CD-Roms.
3. *Wonderwise* 4-H curriculum events need to continue to be available to youth. Youth need to have the opportunity beyond this research to register and participate in events based on science activities in nonformal learning environments.
4. *Wonderwise* 4-H needs to be marketed nationally beyond 4-H based events. Marketing should be made to other nonformal education based organizations such as Scouts, before and after school care programs, camps, and other clubs.

Specific recommendations for scientific role models are:

5. Youth within this study were from a spectrum of ethnicities. There is a need to increase the value placed on scientific learning in all cultures. Youth need to be exposed to a variety of scientific role models on a continual basis in formal, nonformal and informal learning environments. Scientists need to represent a wide spectrum of gender and culture.
6. Science curriculum needs to be designed made up of suggested activities which could be used by the role models already present within children's

lives. Youth need to see the important people within their relationship network doing science.

Recommendations to nurture young women's decidedness around careers needs are:

7. Since youth tend to relate to the careers similar to the role models within their lives, science curriculums need to be designed to create ways to build job shadowing experiences into the curriculum design to expose youth to a variety of different science career choices and role models.
8. Include an adult education section in youth science curriculum designs. The goal of this educational piece would be to help adult role models understand the role they play in youth career decidedness and view of subject matters such as science. This piece could be in the form of a pamphlet or workshop designed for parents or scientist who become role models for youth.

Recommendations based on the National Science Standards include:

9. Science curriculum for nonformal educational learning environments needs to continue to be designed based on the National Science Standards. These national standards should be central in identifying goals and objectives for the curriculum. The learning process needs to include experiential based activities and authentic assessment and evaluation practices.

Implications for Future Research

Questions which emerged for future research include:

1. While this study maybe skewed based on the population studied it is important to look at these same issues within the general population (i.e., the average classroom student).
2. Additional research can expand knowledge about the issue of using scientific role models of similar gender and culture. Does the impact of this role model change if the youth is from a differing culture?…different gender?
3. To gain a more complete understanding of the real impact of role models, successful female scientists should be studied to identify who their role models were as they selected a scientific career. Does a pattern exist across gender or culture?
4. The amount that seeing one video or doing a few inquiry based science activities will impact an individual for life is undefined. What impact would long term repeated exposure to the *Wonderwise* science curriculum have on young women?
5. Additional research can strengthen the process for using young children's stories and drawings, and relationship maps to analyze how youth synthesize scientific processes and the connect with role models.

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APPENDIX A:

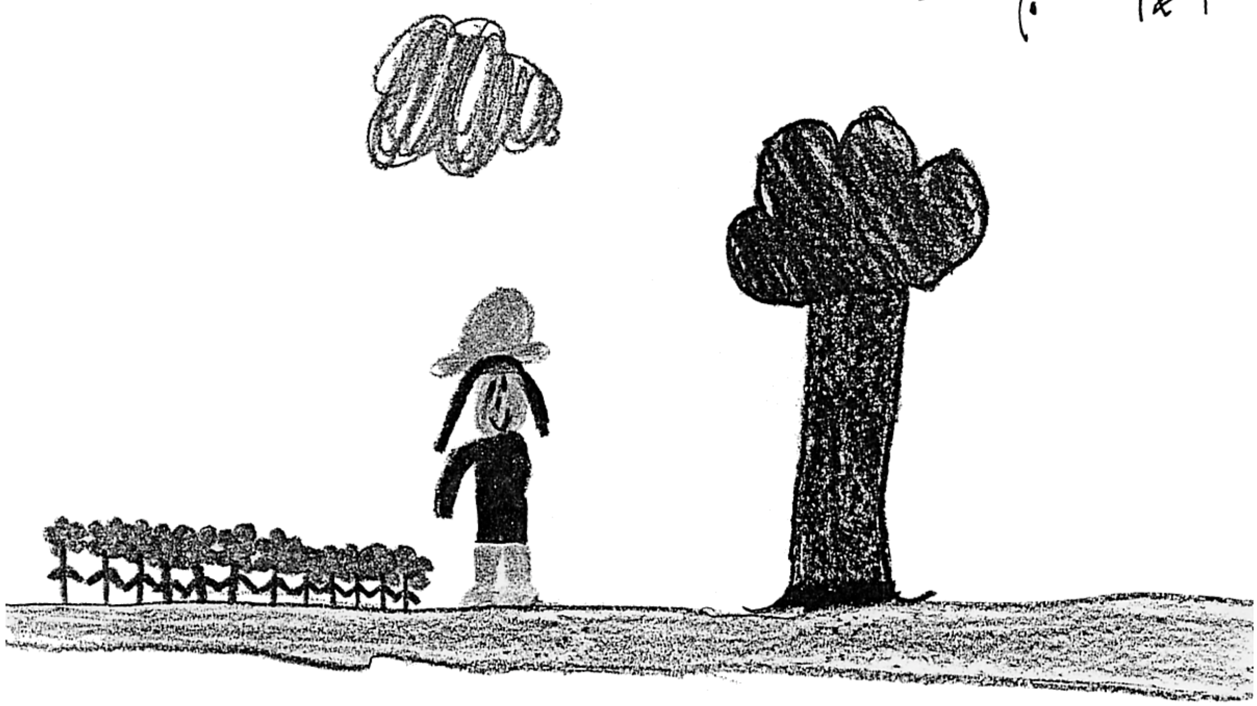
CHILDREN'S DRAWINGS/STORIES

(I.E., PIATS)

PULLING IT ALL TOGETHER

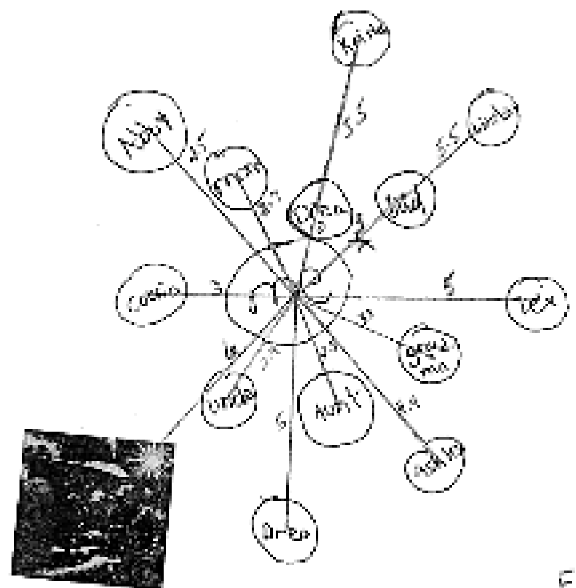
PULLING IT ALL TOGETHER

PULLING IT ALL TOGETHER



APPENDIX B:

RELATIONSHIP MAP



F - 278

FR = 4.98

SC - 6

XS - 77

O10-A

APPENDIX C:

INSTITUTIONAL REVIEW BOARD

University of Nebraska Lincoln

RESEARCH COMPLIANCE SERVICES
Institutional Review Board

May 6, 2002

Dr. Amy Spiegel
Ed Psych
219 TEAC 0384

IRB# 2002-05-304 EX

TITLE OF PROPOSAL: **Wonderwise - 4H Evaluation With 4H Youth**

Dear Dr. Spiegel:

This letter is to officially notify you of the approval of your project by the Institutional Review Board (IRB) for the Protection of Human Subjects. This project has been approved by the Unit Review Committee from your college and sent to the IRB. It is the Board's opinion that you have provided adequate safeguards for the rights and welfare of the participants in this study. Your proposal seems to be in compliance with this institution's Multiple Project Assurance M-1510 and the DHHS Regulations for the Protection of Human Subjects (45 CFR 46) and has been classified as exempt.

You are authorized to implement this study as of the Date of Final Approval: 5/03/02. This approval is Valid Until: 5/03/03.

1. You have received the IRB approved Informed Consent form for this project. Please use this form when making copies to distribute to your participants. If it is necessary to create a new informed consent form, please send us your original so that we may approve and stamp it before it is distributed to participants.

This project should be conducted in full accordance with all applicable sections of the IRB Guidelines and you should notify the IRB immediately of any proposed changes that may affect the exempt status of your research project. You should report any unanticipated problems involving risks to the participants or others to the Board. For projects which continue beyond one year from the starting date, the IRB will request continuing review and update of the research project. Your study will be due for continuing review as indicated above. The investigator must also advise the board when this study is discontinued.

Sincerely,

Sharon A. Evans, Chair
for the IRB

cc: Unit Review Committee

[illegible]

University of Nebraska Lincoln

RESEARCH COMPLIANCE SERVICES
Institutional Review Board

April 3, 2003

Dr. Amy Spiegel
Cr
219 TEAC 0384

IRB # 2002-05-309 EX

TITLE OF PROTOCOL: **Wonderwise – 4-H Evaluation with 4-H Youth**

Dear Dr. Spiegel

This letter is to officially notify you of the approval of your project's Continuing Review by the Institutional Review Board for the Protection of Human Subjects. It is the committee's opinion that you have provided adequate safeguards for the rights and welfare of the subjects in this study. Your proposal seems to be in compliance with DHHS Regulations for the Protection of Human Subjects (45 CFR 46).

We wish to remind you that the principal investigator or project director is responsible for keeping this Board informed of any changes involved with the procedures or methodology in this study. You should report any unanticipated problems involving risks to the subjects or others to the Board.

It is the responsibility of the principal investigator to provide the Board with a review and update of the research project each year the project is in effect. This approval is valid until May 3, 2004.

If you have any questions, please contact Shirley Horstman, Research Compliance Coordinator, at 472-9417.

Sincerely,

Marcela Raffaelli

Marcela Raffaelli, Chair
for the IRB

103 Whittier Building / 2255 "W" Street / P.O. Box 880849 / Lincoln, NE 68583-0849 / (402) 472-6965 / FAX (402) 472-9323

University of Nebraska Lincoln

University of Nebraska State Museum
Division of Public Programs
307 Morrill Hall
P.O. Box 88033[illegible]
Lincoln, NE 68588-0338
Phone (402) 472-6302
Fax (402) 472-88[illegible]
www.museum.unl.edu

Spring 2002

IRB#2002-05-504 EX

Dear Parent of 4H Youth Participant:

The University of Nebraska State Museum and 4H are evaluating the effectiveness of the Wonderwise 4H science learning kits that have recently been developed. As part of the evaluation of these kits, your child may be asked to participate in a brief interview during their participation in the following 4H program, which is planning to use Wonderwise 4H kits:

____

This interview will focus on the material in the kits, on your child's work as part of a kit, and your child's interests as they relate to science. The questions include

- *What did you like best in the [Wonderwise] activities?*
- *Tell me about your story*
  [your child will create a story about a scientist as part of the Wonderwise kit]
- *What do you want to be when you grow up?*

A copy of your child's story from the Wonderwise kit will be included with their answers to the interview questions. The interview will take about ten to fifteen minutes. There are no known risks associated with this study. Before the interview, the evaluation study will be explained to your child, and he or she will have a choice whether to participate or not. We have included, for your information, a copy of the consent form your child will be asked to sign if they decide to participate in the study. The interview will be audiotaped so that we have a complete record of the interview. After the interview is transcribed, the audiotape will be destroyed.

While we will ask for the age and gender of your child, your child's name will not be recorded on the protocol and will remain anonymous in our data. No reports published as a result of this evaluation will include any individually identifying information.

This letter is being sent to help you make an informed decision about your child's participation and has received the approval of the University of Nebraska-Lincoln Institutional Review Board. You are free to decide not to have your child participate without adversely affecting their or your relationship with the investigator, 4H, or the University of Nebraska-Lincoln. Your decision will not result in any loss of benefits to which your child is otherwise entitled. Your signature on this document indicates that you have allowed your child to participate in this study. Please return the signed copy in the enclosed self-addressed stamped envelope. A second copy of this letter is enclosed for you to keep for your records. If you have further questions, please call Amy Spiegel at 402-472-0764 or contact the IRB directly at 402-472-6965.

Sincerely,

Amy Spiegel
Evaluator, Wonderwise-4H

Child's name: ____________________________________

Signature of Parent: __________________________ Date: __________

University of Nebraska Lincoln

University of Nebraska State Museum
Division of Public Programs
[illegible] Morrill Hall
P.O. Box [illegible]
Lincoln, NE [illegible]
Phone (402) 472-[illegible]
Fax (402) 472-[illegible]
www.museum.unl.edu

IRB#2002-05-204 EX

Child Assent Form

Assessment of Wonderwise-4H Kits

We would like to invite you to take part in this study. We are doing this study to learn more about science education in 4H. You can choose whether you want to take part or not.

In this study we want to learn more about your opinions and ideas about some of the things you've done in this 4H program. We will ask you a few questions about some activities and work you have done, and a few questions about yourself. It will take about ten or fifteen minutes.

Your parents have also been asked to give their permission for you to take part in this study.

You do not have to be in this study if you do not want to. If you decide to participate in the study, you can stop at any time. If you have any questions at any time, please ask one of the researchers.

If you sign this form it means that you have decided to be in the study and have read everything on this form. Your parents have been given a copy of this form to keep.

Signature of Student — Date

5/7/02

Signature of Investigator — Date

Investigator
Dr. Amy Spiegel   Office: (402) 472-0764

APPENDIX D:

NEBRASKA STATE SCIENCE STANDARDS

POLLEN DETECTIVE

National Standards as Identified by McRel

McREL www.mcrel.org

Print this Page | Close Window

Subject	Standard	Number	Level
Science	**Standard: 2**	**6**	**Level II: Upper Elementary (Grades 3-5)**
Description: Knows that fossils provide evidence about the plants and animals that lived long ago and the nature of the environment at that time			
Subject	Standard	Number	Level
Science	**Standard: 15**	**4**	**Level II: Upper Elementary (Grades 3-5)**
Description: Knows that scientists use different kinds of investigations (e.g., naturalistic observation of things or events, data collection, controlled experiments), depending on the questions they are trying to answer			
Subject	Standard	Number	Level
Science	**Standard: 15**	**6**	**Level II: Upper Elementary (Grades 3-5)**
Description: Uses simple equipment and tools to gather scientific data and extend the senses (e.g., rulers, thermometers, magnifiers, microscopes, calculators)			
Subject	Standard	Number	Level
Science	**Standard: 16**	**5**	**Level III: Middle School/Jr. High (Grades 6-8)**
Description: Knows that people of all backgrounds and with diverse interests, talents, qualities, and motivations engage in fields of science and engineering; some of these people work in teams and others work alone, but all communicate extensively with others			
Subject	Standard	Number	Level
Science	**Standard: 16**	**6**	**Level III: Middle School/Jr. High (Grades 6-8)**
Description:			

Knows that the work of science requires a variety of human abilities, qualities, and habits of mind (e.g., reasoning, insight, energy, skill, creativity, intellectual honesty, tolerance of ambiguity, skepticism, openness to new ideas)

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AFRICAN PLANT EXPLORER

National Standards as Identified by McRel

McREL www.mcrel.org

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Subject	Standard	Number	Level
Science	**Standard: 6**	**2**	**Level II: Upper Elementary (Grades 3-5)**

Description:
Knows that each plant or animal has different structures which serve different functions in growth, survival, and reproduction (e.g., humans have distinct structures of the body for walking, holding, seeing, and talking)

Subject	Standard	Number	Level
Science	**Standard: 15**	**5**	**Level II: Upper Elementary (Grades 3-5)**

Description:
Plans and conducts simple investigations (e.g., makes systematic observations, conducts simple experiments to answer questions)

Subject	Standard	Number	Level
Science	**Standard: 16**	**2**	**Level II: Upper Elementary (Grades 3-5)**

Description:
Knows that people of all ages, backgrounds, and groups have made contributions to science and technology throughout history

Subject	Standard	Number	Level
Science	**Standard: 16**	**3**	**Level II: Upper Elementary (Grades 3-5)**

Description:
Knows that although people using scientific inquiry have learned much about the objects, events, and phenomena in nature, science is an ongoing process and will never be finished

Subject	Standard	Number	Level
Science	**Standard: 16**	**4**	**Level II: Upper Elementary (Grades 3-5)**

Description:

Knows that scientists and engineers often work in teams to accomplish a task.

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APPENDIX E:

NATIONAL SCIENCE STANDARDS

Science Education Program Standards

The program standards are criteria for the quality of and conditions for school science programs. They focus on issues at the school and district levels that relate to opportunities for students to learn and opportunities for teachers to teach science. The first three standards provide criteria to be used in making judgments about the quality of the K-12 science program. Those standards are directed at individuals and groups responsible for the design, development, selection, and adaptation of science programs. People involved include teachers, department chairs, curriculum directors, administrators, publishers, and school committees. Each school and district must translate the standards into programs that are consistent with the content, teaching, and assessment standards, as well as reflect the context and policies of the local district. Because the content standards outline what students should know, understand, and be able to do without describing the organization of the program of study, program standards A, B, and C focus on criteria for the design of the program, course of study, and curriculum. In contrast, standards D, E, and F describe the conditions necessary to implement a comprehensive program that provides appropriate opportunities for all students to learn science.

The Standards

The program standards are rooted in the assumptions that thoughtful design and implementation of science programs at the school and district levels are necessary to provide comprehensive and coordinated experiences for all students across grade levels, and that coordinated experiences result in more effective learning. But a balance must be maintained. To the extent that district and school policies and consequent decisions provide guidance, support, and coordination among teachers, they can enhance the science program. However, if policies become restrictive and prescriptive, they make it difficult for teachers to use their professional ability in the service of their students.

PROGRAM STANDARD A:
All elements of the K-12 science program must be consistent with the other *National Science Education Standards* and with one another and developed within and across grade levels to meet a clearly stated set of goals.

* **In an effective science program, a set of clear goals and expectations for students must be used to guide the design, implementation, and assessment of all elements of the science program.**
* **Curriculum frameworks should be used to guide the selection and development of units and courses of study.**
* **Teaching practices need to be consistent with the goals and curriculum frameworks.**
* **Assessment policies and practices should be aligned with the goals, student expectations, and curriculum frameworks.**
* **Support systems and formal and informal expectations of teachers must be aligned with the goals, student expectations and curriculum frameworks.**
* **Responsibility needs to be clearly defined for determining, supporting, maintaining, and upgrading all elements of the science program.**

TABLE 6.9. CONTENT STANDARDS, GRADES 5-8

UNIFYING CONCEPTS AND PROCESSES	SCIENCE AS INQUIRY	PHYSICAL SCIENCE	LIFE SCIENCE
Systems, order, and organization Evidence, models, and explanation Change, constancy, and measurement Evolution and equilibrium Form and function	Abilities necessary to do scientific inquiry Understandings about scientific inquiry	Properties and changes of properties in matter Motions and forces Transfer of energy	Structure and function in living systems Reproduction and heredity Regulation and behavior Populations and ecosystems Diversity and adaptations of organisms
EARTH AND SPACE SCIENCE	**SCIENCE AND TECHNOLOGY**	**SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES**	**HISTORY AND NATURE OF SCIENCE**
Structure of the earth system Earth's history Earth in the solar system	Abilities of technological design Understandings about science and technology	Personal health Populations, resources, and environments Natural hazards Risks and benefits Science and technology in society	Science as a human endeavor Nature of science History of science

APPENDIX F:

EVALUATION OF *WONDERWISE* CURRIUCULUM

AND AWARDS

Evaluation & Research

Download Instructions and Assistance
Viewing the research reports requires the installation of Adobe Acrobat Reader which can be downloaded for free from Adobe by clicking here. Just select whether you need the Windows or Macintosh version of the plug-in. Then, simply follow the instructions to download and install the plug-in on your computer. Downloading, Installation and Troubleshooting information for Acrobat may be accessed by clicking here.

Wonderwise (1992-1997) funded by the Howard Hughes Medical Institute

Dates	Evaluation Instrument	Respondents	IRB #	Report Issued
May 1993	Encounter Kit Survey	Nebraska Teachers	N/A	Internal document
Nov 1992 - Feb 1993	University of Nebraska State Museum Survey	Nebraska Teachers	N/A	Internal document
June 1993	Nebraska Statewide Teacher Teleconference	NETV, Museum, Teachers (Lincoln, Scottsbluff, Norfolk, Omaha, Chadron/Alliance)	N/A	Internal document
Oct-Nov 1993	HHMI Survey: Teacher Needs Assessment	Nebraska Teachers	N/A	Internal document
July 1994 – June 1997	Trial Testing Observation Form, HHMI Curriculum Development: Sea Otter Biologist, Pollen Detective, Parasite Sleuth, Rainforest Ecologist, African Plant Explorer	1855 students in 85 classrooms (duplicate count)	N/A	Internal document
July 1995	Arbor Day Institute Trial Testing Forms (Viewing the Video, Biography Feedback, Curriculum and Kit Critique)	18 teachers	N/A	Internal document
Oct 1996- July 1998	CD-ROM Reviews	Development staff; differed depending on specific kit.	N/A	Internal document
Summer 1996	Reflecting on Mentors	19 Mentor	96-06-	**Reflecting on the**

	Wonderwise Workshop	Teachers	365 EX	**Mentors' Wonderwise Workshop** (not electronically available)
Summer 1996	Discussion Questions for Wonderwise Mentor Teachers	19 Mentor Teachers	N/A	Internal document
May 1997	Wonderwise Teacher Pre-Workshop Information	19 Mentor Teachers	N/A	No report issued
September 1997	Wonderwise Kits in the Classroom	381 Teachers	96-06-365 EX	**Wonderwise Participant Teachers Feedback on the Kits**
May 1996-September 1997	Demographics Sheet (Who uses the Wonderwise Kits?) and Wonderwise Workshop Teacher Sign-up Sheet	834 Educators (for designated period)	N/A	Internal documents
January 1997	Mentor Feedback (Mentor interviews)	16 Mentor teachers	96-06-365 EX	**Mentor Evaluation of Kits in the Classroom**
Spring 1997	Observation Study (Classroom observation; teacher feedback on video & activities; student focus group questions; student survey on activity)	75 Students, 2 Mentor Teachers	96-03-282 EX	**Classroom Observation Description with Student and Teacher Feedback**
Spring 1997	Comparison Study (Student survey)	90 Students	97-04-293 EX	**Classroom Comparison Study** • Classroom comparison survey

Wonderwise Online (1997-2001) funded by the Howard Hughes Medical Institute

Dates (planned)	Evaluation Instrument	Respondents	*IRB #*	*Report Issued*
Oct 1997 – June 2001	Trial Testing: Urban Ecologist	328 students, 9 educators	N/A	No report issued
October 1997-June 2001	Demographics (Who uses the Wonderwise kits?)	Educators	N/A	Internal documents
Oct 1997- June 2001	CD-ROM Reviews	Development staff; differed depending on specific kit.	N/A	No report issued
Jan 1998 – April 1999	Sleepovers (Adult and student feedback on kits)	For all 5 Sleepovers combined, 298	97-12-153 EX	**Stupendous Science Sleepovers**

		students, 51 supervising adults		• Sleepover student survey • Sleepover teacher survey
February-March 2001	Teacher Web Survey	113 Educators	2001-02-153 EX	**Teachers Talk about Wonderwise: The Use and Impacts of the Women in Science Learning Series**

Wonderwise 4-H (2000-2003) funded by the National Science Foundation

Dates (planned)	**Evaluation Instrument**	**Respondents**	***IRB #***	***Report Issued***
June 2000 - May 2003	Demographics (Who uses the Wonderwise kits?)	Educators	N/A	Internal documents
January 2001 - May 2001	4-H Trial Testing of original 6 kits: Sea Otter Biologist, Pollen Detective, Parasite Sleuth, Rainforest Ecologist, African Plant Explorer, Urban Ecologist	511 4-H youth at 43 sites (duplicate count)	N/A	No report issued
April 2001-October 2001	Trial Testing: Space Geologist	116 youth at 10 sites (duplicate count)	N/A	No report issued
October 2001	Trial Testing: Vet Detective	308 youth at 15 sites (duplicate count)	N/A	No report issued
Spring 2002	Interviews with 4-H State Contacts	10 4-H State contacts	N/A	In progress
Spring-Summer 2002	Pulling it all Together (PIAT) Study	88 4-H and other youth	2002-05-304 EX	In progress
Winter 2003	Web Survey	4-H Leaders	2003-01-122EX	
May-Sept 2002	Case Study of Wonderwise Use by 4-H (observations, kit use documentation, interviews of youth)	4-H Youth	2002-05-304 EX	In progress

Awards
Wonderwise Women in Science Series

Vet Detective
Golden Aurora Award
Aurora Awards Film and Video Competition
2002

Space Geologist
Golden Aurora Award
Aurora Awards Film and Video Competition
2002

Wonderwise
Award for the Advancement of Learning Through Broadcasting
National Education Association (NEA)
Category: Children's Programming
1998

Rainforest Ecologist
Awarded a Silver Certificate
International Cindy Competition
Category: Education (Science and Math)
1998

African Plant Explorer
Awarded Second Place
8th Annual Muse Award Competition
American Association of Museums
Category: Science
1998

Rainforest Ecologist
Awarded a Gold Certificate
Regional Cindy Competition
Category: Education (Science and Math)
1997

Sea Otter Biologist
Awarded Second Place
8th Annual Muse Award Competition
American Association of Museums
Category: Science

APPENDIX G:

FIELD NOTE DOCUMENT

Observer
Kit
Start time

Date
End time

Activity 1 2 3 4 5 Video Y N

Description of site # youth # teens # adults # small groups # youth/group **Leader(s)** Gender Ethnicity Age Description	**Focal Subject** Gender Ethnicity Age Description	**Focal Subject** Gender Ethnicity Age Description
Description of activity start finish	**Focal Subject**	**Focal Subject**

Site Site code

Description of activity start finish	Focal Subject	Focal Subject

Site code

page

Description of Site

Other Notes

Site code page

APPENDIX H:

YOUTH SEMI-STRUCTURED INTERVIEW PROTOCOL

Interview Protocol
Wonderwise Child Interview

Introduction:

My name is_______________. I'm talking with you and other youth to learn more about some activities you did. I'm interested in your opinions and ideas, there isn't a right answer. (Read consent form to child) Sharing these ideas with me helps make this program better. I will be recording our conversation so I don't have to write down every word. Do you have any questions for me? (Pause for questions) (Hand child the consent form to sign)
Thank you for taking time to talk with me today.
Icebreaker: I understand 4-H clubs have a name. What is the name of your club?
Probe: How did it get that name? (or might include questions about the event

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Time start: ______
Have child's booklet in hand and open to page with scientist story/drawing)
1. (Begin With a positive comment about drawing/story)Tell me about your story/drawing. If child is not finished offer to write down as they dictate. Tell me what else you would have added. I'll write it down for you!
Probes: Tell me more. What else can you tell me about your story/drawing? What is your person in you story/drawing doing?What would happen next? Who does he/she work with? Tell me more.
How did they (insert name if given by the child) become a __________? Tell me more. Is there anything else you would like to tell me/add to your story/drawing?

2. You also did some activities. Tell me about the activities you did.
Probes: What do you like best? What surprised you? Why did ____surprise you? Did this have any connection to anything you know?

3. Tell me about the video you watched.
Probes: What do you remember about the people? Tell me about the work in the video? Tell me more. What surprised you? Why did _____surprise you?

Go back to story/drawing. Is there anything else to add to your story/drawing? (Have paper/writing tools available.)

4. What do you like to do at school?
Probes: Tell me more about ________?
Why is it you like to do this?

5. What kinds of things do you want to do when you grow up?
Probes: Do you know anyone who does that? What about that _____ interests you? What would you need to learn how to do to____ this?

6. If you were going to do science what kinds of things would you do?
Probes: Tell me more about _______. What interests you about _______?
(Offer paper if they would rather draw or write about science.)

---

7. Let's talk about people who do science. Pick the cards that go with people who do science.
Probes: Go through cards with youth. Ask if they want to change any cards. Are these the cards that go with people who do science? What can you tell me about these cards? (Staple cards to interview protocol upon completion)
So tell me about a scientist. What kinds of things do scientists do?

Is fun	Is not fun
Works outside	Works inside
Has kids	Has no kids
Likes work	Doesn't like work
Is a man	Is a woman
Is boring	Is interesting

8. You might remember when you were at school, diagrams of the planets that looked like this (The interviewer should draw a fresh picture while participant looks on).

I'm going to ask you to make a similar drawing, only instead of putting the sun in the middle , I want you to put yourself there. (Give youth paper and makers)

Around yourself, I want you to arrange the people who are important to you. People who are close to you should be close to you on the drawing.

Please label each circle with the name of the person who belongs there.

Add or mark on this drawing someone you would like to be like when you grow up.

Tell me about the people in this drawing. Probes: Who are they? How are they important to you? Tell me about _______ that you marked as someone you would like to be like when you grow up. What makes that person someone you would like to grow up to be like? How do you know them?

Here is a sticker with (the scientist the child has just seen in the video) Where would you place them on your drawing? Probes: Tell me about why you put them there? What makes them like (who ever is closest)? What makes them different to ______? What else can you tell me about this scientist?

Thank you for helping me learn more about you and your story/drawing.

Participant ID #:________________

Date:____________

Age:_____(Chronological age) Gender : M F
Grade: ______
Ethnicity: White/Not Hispanic
Hispanic
Black
Native American
Asian
Native Alaskan
Native Pacific Islander
Other

Kit/Activities:

Kit 1: Sea Otter Biologist/Brenda Ballachey
- 1.1 Otters in Action
- 1.2 Kelp Critters
- 1.3 Otter Smorgasbord
- 1.4 Tracking Otters
- 1.5 New Wonders

Kit 2: Pollen Detective/Peg Bolick
- 2.1 Pollination
- 2.2 In Search of Pollen
- 2.3 Medical Mystery
- 2.4 Flower Engineers
- 2.5 Pollen Tracks
- 2.6 New Wonders

Kit 3: Rain Forest Ecologist/Janalee Caldwell
- 3.1 Nutty Investigations
- 3.2 Frogs Up Close and Personal
- 3.3 Build a Tree
- 3.4 Rainforest in Your Room
- 3.5 Life in a Nutshell
- 3.6 New Wonders

Kit 4: Parasite Sleuth/Judy Sakanari
- 4.1 Classy Parasites
- 4.2 What is a Parasite?
- 4.3 Pet Parasite Detective
- 4.4 Parasite Sleuth
- 4.5 The Traveling Tapeworm
- 4.6 New Wonders

Group 4-H
Leader:____________________________

Interviewers Name: ________________

Interview Length:___________________

Location:__________________________

State:___________

Kit 5: African Plant Explorer/Fatimah Jackson
- 5.1 Everyday Poisons
- 5.2 Investigating Starch
- 5.3 African Arts
- 5.4 Green travelers
- 5.5 New Wonders

Kit 6: Urban Ecologist/Carmen Cid
- 6.1 Sound Sense
- 6.2 Cool Tool
- 6.3 Seedy Travelers
- 6.4 Walk on Water Bugs
- 6.5 Drain Game
- 6.6 New Wonders

Kit 7: Space Geologist/Adrianna Ocampo
- 7.1 Meet Adrianna
- 7.2 Crater Maker
- 7.3 Vanishing Craters
- 7.4 Big Time Tour
- 7.5 Digging Into the Past
- 7.6 New Wonders

Kit 8: Vet Detective/Tolani Francisco
- 8.1 Meet Tolani
- 8.2 Bison Behavior
- 8.3 Vital Signs
- 8.4 Rumination
- 8.5 Disease Detective
- 8.6 New Wonders

May 29,2002

APPENDIX I:

INTERVIEW TRANSCRIPT

Wonderwise Child Interview
Date: 7-1-02
Subject: 010-C
Female
African American
Age 9
Grade 4
Location: Camp Clover
Length: 29 minutes
Interview Conducted by Dee Acklie

Subject 010-C was chosen because she was an African American female within the target range. She was quite verbal. She showed leadership abilities. Though she was one of the younger ones in the group she was well linked into the social hierarchy of the group. Her teachers talked of her as a leader within the group.

Interview Questions:
D: Are you in 4-H? Are you in a 4-H club? Or are you just doing this here?
Y: Just here.
D: what do you like to do?
Y: Well…I like to sing. Um…I like science.
D: Oh, good then this will be fun for us to talk about.
D: **Let's start with your story here?** We're going to look at your story first. I noticed you took a lot of time. You were really working on that story. So…could you tell me about your story?
Y: Well…first I had this scientist and she was just studying and she said that I ….I need to find more pollen to study. So she went outside and she found this big tree and she figured that might be something on there. She looked and she found some pollen and…a little cone…the little balls that are out there. And then…she said I wonder what this is…because she had just started. And her …other big sister, she said that it was pollen. She said, "This is pollen. Why don't you study it?" Three hours later she said, "This is very cool! I think I might want to be a scientist when I grow up!"
D: Oh, great story! Now I know you were still working on it when we made you guys kind of stop. You were just finished. What else could you tell me about your story. If you'd have had all the time what else would you tell….
Y: Well…I would give it …so what she was looking at before…and when she studied what she had studied. What she had saw. That shapes…um…I think that I would have a lot more things to say like…if she had …before…she had studied clover or something.
D: Ok, Now does your scientist have a name?
Y: Um…I think…I haven't named her before but one of my favorite names is Melody so…
D: You think you would name her Melody?
Y: Yes
D: Ok, who do you suppose she would work with?

Y: Um…I think she would work in…where…in the building where…she's mostly outside but she would come in just to study it. And she would…stay in one area but yet it's more than 10 countries.
D: Ok, so it would be a big area?
Y: Yeah.
D: How do you think Melody got started being a scientist?
Y: Um…I think that…she just… finding something to do and maybe one of her were studying scientists and she said, "Why don't we do this and this?" And her friend went in a different part and she went in this part. And she got very interested in to when …when was a kid. And so she just moved into it.
D: Ok, if you could do anything with this story…If I gave you all the art materials and lots of paper and you could work on it as long as you wanted. What else would you do with this story?
Y: Um…I think I'd make it into a big book. And I would have…some things pop out and some things were you could actually have materials when you look that come with the book. I think that I would have just about everything that you could have.
D: What kind of things would you have pop out of your book?
Y: Um…a little microscope.
D: Oooooo…
Y: You could have…a shape of what the pollen would look like just pop out when you open the page…Umm….If she was excited she could pop out.
D: What kind of things would you include for the kids that read your book to work with?
Y: Ummm…what do you mean by that?
D: Well…you said you would include some things for them to work with. And it was…
Y: Yeah! Well, things that you could actually see. I would try to make a …probably …if I had like you said enough …enough material I would probably try to make a microscope a little one and… see how you do it and what I thought about it.
D: Ok, ok…What else would you like to tell me about your story here?
Y: Um…I put a lot of picture into it. I usually…I …I like to draw, too. Some of this stuff I kind of rush it in, but…I try to um…put a lot of details into it like the microscope you see…her try to look into it instead of it just sitting there. And…um…yeah, I like to draw. So I just try to put details into it.
D: Ok, all right. **You also did an activity today. Tell me about the activity that you did.**
Y: Um…we tried to find… we took a bucket of sand and we had these little… I called them sand cookies cuz they kind of looked like cookies that…
D: Yeah! I think they look like sand cookies. Sand cookiesthat's a good explanation for them.
Y: So I just um…And so they were hidden in the sand and so I just poked around a little bit…not to much to break it. And…I found 1 in each one and I got to do 2. But I didn't break 2 so…I found pollen inside of these. They…were actually beads but we had to put down the types of pollen like…if they were real ...we would look in a microscope and look at what shape they are…And I guess I could write them down…And…um…it was really fun. Like I said I thought it was better than school!
D: Oh, it was better than school! What'd you like best about it?

Y: I liked the mess…cuz I love to…love to act...I like to pretend that I'm things that…I'm really …not but …I can be when I grow up or something. And I thought that I'm a scientist and …I like it because it actually …they actually put into it like you were actually doing this thing as a scientist.

D: Ok, What surprised you?

Y: Um…actually it surprised me that vinegar would make the sand cookies actually fizzle like that. I mean I've thoug…seen things but I never thought sand and vinegar would do that together.

D: Ok, did this have any connection to what you already know?

Y: Um…I know…that…let's see. That you should always try to look and find things and…you always count after that. I knew that!

D: You knew about counting?

Y: Yeah!

D: Anything else?

Y: Um…I had a lot of fun that's….

D: You had a lot of fun with this. **You watched a video on the video screen.**

Y: Uh huh

D: Tell me about the video that you watched.

Y: Well…I liked it because…they actually brought you inside…sometimes when you watch movies that other people…show it's just…they sit down in a chair and tell you the story. I liked it because she actually showed you around and…I didn't know that they used…that there's pollen in trees. Um…I think that she taught me a lot of stuff I didn't know there was pollen in…um…in…soil and putty and stuff like that . Um…when she said it …usually all I think of is…if someone says measure pollen I think of flowers that's all! But now I know that people actually study these things and they actually put their best work into it. And…I thought it was something that scientist would just measure around where they actually find it and then they went back to what they were working on before…but…now I know so…I think that was very interesting.

D: Did that surprise you?

Y: um...well…it surprised me that I did not know that…only…women could not do what she wanted before. You can't study huge fossils. I did not know that. I thought that any woman or man or any college could do that. And…

D: Do you think women could do it?

Y: Yes! And…

D: Do you think Peg thought women could do it?

Y: Huh?

D: Do you think Peg thinks now that women could do it?

Y: Yes!! I think she thinks that anybody can do it!

D: And you agree with her?

Y: Yes!

D: So…Why did that surprise you that they told her that she couldn't do that?

Y: Because…I think now that sometimes …yes, men are stronger than women but…Women can be smart, too! It just depends on who you're working with.

D: Ok,

Y: And…what kind of…what they experienced and what they haven't. And I think they should look at that person and…look at…what…who they really are inside. Then…who they are because if they're a female or a male or …if they're strong enough or weak enough or because…um… I just think that in some ways we're equal!

D: Ok, all right! We're going to look one last time at that drawing you did in your story. Is there anything else you want to tell me about it before we put it away in the other stuff.

Y: Um…um…not really. I think that my biggest thing is that I wanted to put a lot of detail so…

D: And there's lots of detail in your story. I'm going to save that over here with your signature. **What do you like to do at school? You told me this was better than school so… what do you like to do at school?**

Y: Um…well...I like art. I like science. Actually I love art! I mean would do anything…

D: You love art and you like science ok.

Y: I would do a lot of stuff for art and um… I like my school…well…do you want me to tell you why I like my school?

D: Sure what ever.

Y: I like me school because…they are kind of like you guys…they will put fun stuff into it! When…when I was little and somebody mentioned school I thought …ah this is going to be so…boring! All you do is read…but I love reading now…but…all you do is read and sit there and listen… as the teacher says blah, blah, blah! My teacher! Is good with my personality. She really helps me with things. She's…she will sit down and really listen to you as an individual instead of doing it as a group.

D: Oh that's cool!

Y: And I think she fits…I think that…the principal put me with her for a reason!

D: Ok, so what do you love about art?

Y: Um…I love to…create stuff… new things. Discover new things and…just…have fun. I like to have fun and sometimes when I'm serious I put my best work into what I've done…I just say WOW! I did that! I just wanted to add on…you asked me what I like to do I collect rocks.

D: Oh, you collect rocks.

Y: I have a whole bunch at home. Matter of fact…sometimes I go to Michigan and…when I'm at Lake Michigan I take a regular rock that I've found and I throw it at the sand and if I hear a click then I know that there's a rock there. So I dig it up and take it! And…I really enjoy just looking around…I've found some fossils before.

D: Wow!

Y: Just little ...designs in it. And…I've been running down to the Mississippi…so…I've found a lot of rocks.

D: That's great! Is that what you like in science too is rocks?

Y: Yeah! I love rocks! Of somebody asked me to trade a doll …a Barbie Doll for rocks I would definitely!!

D: You would do it huh?

Y: Yeah!

D: What do you do with the rocks? Do you classify them? Or polish them….

Y: Well…some…at first I didn't know how…to polish them. And one of my friends…one of my mom's friend's friend *(giggles)* She told me…that you could make your rocks shiny. And a way of taking nail polish…these clear nail polish and just paint all over it!
D: Oh!
Y: So I bought that just …not to long….I haven't tried it yet because I like just got it! But I'm going to try it...and I like just to…set up my rocks um….play…not play with them but… compare them to other rocks and…how and ..why I like them and stuff like that!
D: Ok, **What type of things do you want to do when you grow up?**
Y: A singer! Like I said earlier…I love to sing. I…I actually I'm in singers choir at my church. It's a small group. We have about only 4 or 5 people. Our church just started my Grandma's church. And um… I sing some lead parts sometimes.
D: WOW!
Y: Yeah! I love to ding I have my grandma's voice!
D: Do you know anybody who does that? Who's a singer?
Y: Um…would you mean like somebody I've met personally that's a singer?
D: uh huh or just somebody that you like.
Y: Somebody I like because of that reason? I like Christina Aguilara. So…I know people who don't like her. But…I like her because …she…if you were singing Amazing Grace… and you were just singing it plainly she would put some just… moan into it so it would make a little Shhhh…not….like a straight line but kind of curvy and I like that! I do that sometimes when I make up songs. I like to…I write songs. I make up my own songs.
D: Awesome!
Y: Um…so…I just like her because…she will take stuff and make it into new things. She can use with that and go that's mine! And I made it! I'm proud of myself! Um…I guess I like people because…sometimes I like new. I love new. I love music, too. I mean um…I've never heard of any writers, usually they don't ell people writers. If I could find a writer…I'd probably listen to them. I'd probably give them some of my songs!
D: Oh, that'd be a good thing to do.
Y: I…like to listen to beats…
D: You like to listen to the beats?
Y: Yeah, if my grandma has an electric computer…or a electric piano. And sometimes I make my own beats up with it! Because they have drums and stuff like that.
D: Sure! What would you need to learn how to do in able to be a singer?
Y: Um…I definitely need to learn how to…accept somebody if they said they didn't like me song. And I can't accept that! But…when I say anything about that I don't expect them to say I like it… but I do expect them not to say I think you should make some changes in that. Because…I know if I get a director…I'm going to get a director, I know that they're going to have to say that. That's their job! And um…I'm going to learn how to…just be able to go on! Because…I know that …I love my family….I would like to stay with them but…in fact I might move um…later this year. And um…at first I was kind of harsh because I live with my grandma all my life… and I have lived with since I was a baby and…I'm going to move 5 hours away

from her…since I'm moving to Michigan. *(Background noise increases as others come in for snack)* And ah…it's going to be hard for me. I know I'm going to have to travel and …I love to travel. I just went to…I think it was La…I don't remember! I just went to um….I just went to…I think it was 5 states and it took us about …4 hours…but yet it seemed like forever because we woke up at this time and got to bed at this time and….2 o'clock in the morning actually! And we had to go to church that day!

D: Oh! That was a long day!

Y: I have to be able to do this because it is going to be hard for me. And um…it's going to be hard for me…to leave my family. I think that's the biggest ….cuz I'm going to have to move. I think I'm going to have to look out there to find people so that can help me be a singer!

D: So you can get better!

Y: Yeah! And…in Illinois you don't find as many singers…that's the truth…I live in Rock Island so…

D: Ok, **If you were going to do science what type of things would you do?**

Y: Um…I think I would probably study rocks like I said …fossils or rocks. Um…

D: What about that interests you? *(Background noise increases)*

Y: What?

D: What about studying rocks interests you? Or fossils?

Y: Well…like I said I love to discover things. And rocks that's like the most thing I can think of. I mean yes, you can discover things in different ways …like dive down in the ocean, but…I can do that by finding rocks. I can go many places...like I said I like to travel. But yet… it's fun to…I know I'm going to come back. So…I think I'm just comfortable. See rocks… rocks are basically just like treasures tome!

D: Uh huh

Y: My grandpa, it's kind of weird. He collects Hot Wheels. He trades them. When I grow up …I kind of want to be like that! My teacher actually, she collects…she collects rocks too.

D: Oh… so you guys have…

Y: So…yeah! So basically it's just like their diamonds to me! I'd trade them but I would never give one to somebody for nothing! I mean…I'm might give them to someone for a gift or something. I treasure my rocks very much! Some people will just go…Why do you collect rocks? They're rocks! They just collect something that people make. Um…well…they're different. I like being different than people! Then just to…try not following the crowd and… it's …it helps me to do… sometimes relax! When I think about my rocks and stuff. It's just…I'm sure other people…who say why do you collect rocks…they probably collect something else. That's how rocks are to me! They're just different!

D: They're just different. **We're going to talk about people who do science. I'm going to give you some cards… I want you to read them. If they're somebody who does science put it in one pile. If it's not somebody who does science put it in the other.** So

Y: Ok

D: So read the first one.

Y: It is fun.

D: Is that somebody who does science?
Y: Um…well…do you mean that they have fun?
D: Could be yeah!
Y: Um…science. Doesn't like work…Wouldn't be science…Um…Work outside…Science! Has not kids…That could be both couldn't it?
D: You decide. *(long pause)* You can put it at the bottom of your pile and come back to it.
Y: Yes! Um…is a woman…likes work…I think that one would be science. Is boring…I think that they would have to be interested in science…so I think that…it really depends! It depends on who you are! To say they're boring or not!
D: Ok
Y: Works inside…I think that is a no so… is interesting …um…I think that's Science…is a man…I think that depends. Is not fun…I don't think that's a science. All depends on that's a question actually. I think! Has kids….
D: So…What are you going to do with those you have for both? Are you going to put them in the science pile or not?
Y: Is it ok if I put like…has kids and has no kids in science?
D: If that's what you want to do.
Y: Um…is a man…is a woman…in science…works inside…in there because I put works outside in there too.
D: Any cards you want to change around?
Y: Um…actually…no! Because…doesn't like work. I don't think they would be in science because …I think that you...it's better to have a bad job as long as you like it. Whether you get a lot of money or not! But is boring is really your opinion. It's not a fact and so…and the same with is fun. So…
D: Tell me about what you put in that pile. Read them to me to make sure I got them all.
Y: Ok. I have...works inside
D: Got it!
Y: Works….
D: Is a man… is a woman right?
Y: Yeah…but I'm trying to find works outside. Works outside.
D: Ok
Y: Is fun. And…is boring is in the other side. Um…is a man and is a woman. I think they could be both! Has kids and has no kids. I think could be both again even though…you'd be busy but still. Is interesting. I think that would definitely be a science and likes work. That would probably be a science too.
D: Tell em about these cards. *(Background noise increases)* Anything else?
Y: Um…these cards…do you mean like if I could change them?
D: No! You know … you tell that this is what a scientist is about. Right?
Y: Yes!
D: This is all about scientist. So tell me about this scientist. What kind of things would this scientist do?
Y: Um…I think that… this scientist…might…take their work inside and outside. They could…could do pollen. Because you have to clean pollen and make sure that it is pollen and so… it is inside and outside. And um….I think that….to like work…you probably would be a scientist because …um…you would…you would pick your …to

be a scientist for some reason and …I don't think somebody would force you to be a scientist.

D: Ok

Y: It's a lot of hard work so…is fun…yes! Actually, is fun could probably be on both because…like I said again it's an opinion. So…it's not a fact. And um…a woman or a man. Well….if this was a scientist…if they studied fossils then it would probably be a man. Like…unless they changed the rule! But…apart from that they'd probably both be…

D: Ok very good! **We have one more thing. I'm going to pick these cards up and get them out of your way. I'm going to ask you…I bet you've seen a drawing like this. Here's the sun…and around it there's planets. Have you seen a drawing like that? Some of the planets are closer to the sun and…some of them are far away. Have you ever seen a drawing like that?**

Y: I think…that you'd find them on a map maybe? Sometimes….a part from that it reminds me of a web.

D: It's kind of like a web. What I'm going to have you do…is I'm going to have you make a drawing like that. Instead of having the sun in the middle, I want you to put you in the middle. I'm going to let you use my clipboard here and here's a pencil.

Y: Ok

D: Put you in the middle.

Y: Just a circle and put my name?

D: Just a circle is fine and put you in the middle.

Y: I don't put other body…

D: However. *(long pause with a lot of noise)*

Y: Ok

D: Ok, just like I put the planets around it I want you to put people around you. People that are important to you and the ones that are closest to you , you'll make close to you. But the ones that are important to you but not close to you you'll put further away.

Y: Um…I call my grandma Mama…do you want me to put Mama or…

D: That's fine…you can put whatever put…

Y: I have 2 Papa's so I'm just going to put Papa and then Papa again.

D: That's fine. It's your map.

Y: Um…I have no sisters or brothers, but…I'm going to. My mom's getting married.

D: Oh! How exciting!

Y: Yes, I'm going to have a sister and a brother. So…um…

D: Where would they go on the map?

Y: They are one of my favorite friends so…I'm going to put them not to far away from my mom and my family. Um…We call my sister Cece and we call my brother KC. My sister's name is actually um…um…is actually Carolyn. Even though my brother's name is really Kasey.

D: Ok

Y: Oh I think um… oh and James that's gonna…that's gonna be my mom's husband.

D: Ok

Y: I think if you would have caught me later…after…about over October they would be one of my close family so um….

D: Ok
Y: I have…never mind…Do you mean? I'm sure you're not thinking about animals.
D: You can put who ever you want on your map.
Y: Ok….it's hard for me to spell Lanora. It's really Lablanca Lanora but we call her ET so I'm just going to put…
D: Who's ET?
Y: Well …she's my cat …
D: Your cat. Ok
Y: She's really a kitten but…um…they comforts me when I'm sad and stuff. This may sound kind of weird but I think they know! I kind of think that they know so that…
D: Ok, anybody else?
Y: I'm going to put L for Lanora.
D: Ok, and she's your cat too?
Y: Uh huh!
D: OK
Y: My best friend! Jen…I been with her for about 10 years and this year coming on4..she'slike…I tell her a lot of my secrets… She's there for me…so she's one of my close ones! I think she is my family…a part of my family.
D: Ok
Y: I think…*(long pause) (Adult giving going home directions in background)* I'm listening sorry.
D: That's ok
Y: Um… I have…let's see Ana…my cousin. Ok…she's my cousin…she um…lives actually in Chicago so…I don't get to see her as much…but…cry…I love her so much that I cry when we have to leave so…
D: OK
Y: She's one of my close ones
D: It sounds like you have some very neat people in your life!
Y: Yeah!
D: Now you can either add somebody on this drawing or you can put a star on somebody on this drawing that you would like to be like when you grow up.
Y: Um…I think I want to be…Can it be more than one person?
D: Sure.
Y: (pause) My mom and my Grandma. They act alike but they're different.
D: Ok
Y: My grandma I like her because…um...she encourages people a lot. She would never tell somebody you can't do this. *(A lot of background noise)*
D: they're loud!
Y: Yeah! She could never tell people that…she would never tell a person that you can't do this unless she is absolutely positive…she know s that you just really…you can do it! And um…my mom she just ….she would never… she loves people…if somebody is …if somebody has a problem and they don't know…I like…say that maybe me and someone else. She would try to help and tell the person …at the same time not try to hurt their feelings. I like her because she tries to work it out with people.
D: So you've got a cool mom!
Y: Yeah

D: I've got a picture of Peg, from the video. Where would you put her on this drawing?
Y: Um…
D: Peel it off and stick it on there.
Y: If I knew her I think she would be right in between …right a little bit …near my future family is and where my cousin is…because she's taught me things and I think that's really cool for her. She's shared things with other people, who she really doesn't even know. So…
D: Is there anything else you would like to tell me about Peg?
Y: *(Background noise is extremely loud)* Peg…is…it seems like she's a nice girl. I would really like to meet her if I could. It seems like she's just… I think she'll do a lot of things for someone. If someone means it…from the way I look at it she'll probably do it cuz she looks like she'll try things. So…she's really cool!
D: Thank you *(gathers demographics)*