SLiC: Family Science Backpacks for Preschoolers

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SLiC: Family Science Backpacks for Preschoolers

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by

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CHAPTER 1

Introduction

In this senior project, I reviewed existing literature regarding science instruction in preschool classrooms, young children’s capabilities and interest in learning science, what science is happening at home, as well as preschool teachers’ feelings toward teaching science. I explored the possibility of bridging the gap between the school and home environment by using a prepared informal learning tool that students could take home and complete with their family.

During the years children are in preschool, they are forming their understandings of the world around them (French, 2004; Nayfield, Brenneman & Gelman, 2011; Eshach & Fried, 2005). In developing these understandings, their natural curiosity prepares them for the beginning ideas of science (Eshach & Fried, 2005; Cowie, Otrel-Cass, 2011). Research is beginning to show that children can not only understand scientific concepts, but they also enjoy learning about them (Eshach & Fried, 2005; Cowie & Otrel-Cass, 2011; Nayfield, Brenneman, & Gelman, 2011; Siry, Ziegler, & Max, 2011). Researchers further argue that preschool-aged children should be exposed to science early because this will help in understanding scientific concepts later on (Eshach & Fried, 2005).

Even with supporting research, science is the least taught subject in preschools (Nayfield, Brenneman, & Gelman, 2011; Maier, Greenfield, & Bulotsky, 2013). Studies reveal that teachers deal with a mixture of challenges that influences the amount of science being taught in the classroom. Some of the challenges that teachers face include: the teacher’s own personal attitudes and beliefs, pressure from schools to focus more on literacy, and a lack of utilizing curriculum that includes science lessons (Greenfield et al., 2009). As a result, researchers are developing science-based curriculum, but little research looked into ways to use science as a connection between the classroom and home (Barbour, 1998; French, 2004; Gelman & Brenneman, 2004; Grenfield et al., 2009). Studies show there are many
science learning opportunities at home that can have a positive effect on a child’s development (Kopan et al., 1997).

In my senior project, I created science backpacks that could be used to bridge learning between the science curricula offered at school and the science learning opportunities that can be fostered by parents at home. My project consisted of two phases: development and pilot testing. I developed three Science Literacy Connection (SLiC) backpacks that consisted of science-themed children’s literature, science activity instructions, as well as the materials for the activities. Observations completed at the Montessori Children’s School determined the three themes chosen for the backpacks, which include Cloud Types, Food Chains, and Acids and Bases.

After completing all of the backpacks (Name that Cloud, What’s on the Menu?, and pH fun for everyone), one was chosen to go through further testing. The “Name that Cloud” SLiC backpack went through a series of observation-based pilot-testing done at The Cal Poly Preschool Learning Lab, before being sent home with a preschooler from the Montessori Children’s School.

The first field-test was done at The Cal Poly Preschool Learning Lab with the director and a 5-year-old boy. The child began by taking items out of the backpack until discovering the Weather Window, in which he became interested in matching all the different clouds in the sky to a picture on the window frame. After the child’s initial curiosity the director and the child began to read the different books included in the backpack. Using non-immediate talk, while reading Shapes in the Sky, the director used questions to challenge the 5-yearold critical thinking about the sky above him. After they finished reading Shapes in the Sky, the director asked, “would you like to make a cloud?” the child agreed and they headed inside. The pair attempted to follow the directions for the Cloud in a Jar activity, but they were unable to create a cloud in the jar. They tried 3 different times, each time trying
a new method suggested by the child. Based on the results of the field test, the backpack was changed after the first observation.

The second field-test was also completed at The Cal Poly Learning Lab, this time utilizing a student-assistant and a 3-year-old girl. An activity from the backpack was introduced by asking questions about the sky. After the 3-year-old answered the questions, the student-assistant moved into reading *Shapes in the Sky*. While reading the story, the student-assistant and child attempted to find the different clouds that were in the sky based off of the cloud descriptions in the book. After the book, the pair engaged in the Weather Window activity to either confirm or change previous thoughts of what clouds were in the sky.

After the second observational field test went successfully, the backpack was sent home with a preschooler from the Montessori Children’s School. Parents were asked to complete a questionnaire at home that described their family’s experience with the SLiC backpack. The questionnaire also asked parents to evaluate what they saw as positive and negative parts of the backpack. When returned, the backpack was missing a couple materials, as well as, the questionnaire came back with positive feedback on the families engagement levels with the activities.

Field-tests completed on the “Name that Cloud” SLiC backpack suggested that children and adults positively engaged in science-related activities while exploring the backpack contents. As a result, I felt that the “Name that Cloud” SLiC backpack achieved what it was designed to do, which was to increase preschool children’s exposure to science as well as encourage parent-child interactions.

One concern is that I created three backpacks, but only one of the three went through field-testing. A related issue is that the “Name that Cloud” SLiC backpack was only tested by a relatively small number of subjects. Further, out of the three tests that were completed, only one consisted of the intended context of use in which the backpack is taken home with a child.
The materials provided in each of the backpacks model an appropriate interactive approach to fostering children’s learning in science.
CHAPTER 2

Literature Review

Research is beginning to show that children can not only understand science, but also enjoy learning about it (Eshach & Fried, 2005; Cowie & Otrel-Cass, 2011; Nayfield, Brenneman, & Gelman, 2011; Siry, Ziegler, & Max, 2011). However, for many children, preschool is their first exposure to a prepared learning environment. In addition to a focus on helping children develop socioemotional and self-regulatory skills, preschool curriculum is designed to promote children’s investigation of such academic topics as: language arts, math, reading, physical education, art, social studies, and science. Regardless of the current research, science is avoided by many teachers in preschool classrooms (Nayfield, Brenneman, & Gelman, 2011; Maier, Greenfield, & Bulotsky, 2013). In addition to school, children also have the possibility of being exposed to these academic topics at home in a more informal manner (e.g. picture book reading, museum visits) (Leung, 2008; Monhardt & Monhardt, 2006). An open question is whether and how efforts to bridge the classroom environment and the home environment can be effective in fostering preschool children’s science learning interest. To pursue this question, it is important to investigate research findings regarding why it is developmentally appropriate to engage preschool-aged children in intentional science learning. It is also vital to consider how science learning is being supported and limited in both the home and school environment. This information is essential to efforts to explore the possibility of introducing science activities that bridge across everyday formal and informal learning settings.

Developmentally Appropriate Science Experiences for Preschool Children

Eshach and Fried (2005) reviewed various studies about preschoolers’ science learning and proposed several reasons why preschoolers should be exposed to science. First, during the ages that children are in preschool, they are actively constructing understandings of their world. The construction taking place causes children to be full of curiosity and this natural curiosity is one reason that makes
science so fitting for children of this age (French, 2004; Nayfield, Brenneman & Gelman, 2011; Eshach & Fried, 2005). Children take part in collecting, observing, and playing in nature which prepares them for the beginning ideas of science (Eshach & Fried, 2005; Cowie, Otrel-Cass, 2011). During this time children also ask a lot of questions about themselves, as well as the world around them. Callanan and Oakes (1992) performed a diary study in which they had parents record the various questions their children asked. Some of the questions Callanan and Oakes (1992) recorded include, “Where’s my brain?,” “Why doesn’t this baby have teeth and the other child does?,” and (referring to the moon), “Where’s the shadow?”

In addition to exploring and asking questions children of this age are also forming opinions about what they like and what they don’t like. It is therefore important that children gain early exposure to science because the experience can help to develop positive attitudes towards science later on. A positive attitude toward any school subject is related to achievement and encourages lifelong learning of the subject in both formal and informal settings. If a positive attitude is formed towards science at an early age, it can lead to the child’s success in the field of science in the future. (Bruce, Bruce, Conrad, & Huang, 1997 as cited by Eshach & Fried, 2005).

Eshach and Fried (2005) further argue that preschoolers should be exposed to science because exposing children to various scientific experiences early will lay a foundation to assist children in being able to understand the scientific concepts later on. Sakes, Trundle, Bell, & O’Connell (2011) conducted a longitudinal study to see how science education in kindergarten influences science achievement later on in third grade. The study included 8642 children from both public and private schools. The study consisted of teacher questionnaires, a general knowledge test in kindergarten, and an achievement test in third grade. The results indicated that the children’s prior knowledge of science before kindergarten was statistically significant in predicting their science achievement at the end of kindergarten, as well as at the end of the third grade. However, the study showed that the frequency and duration of science
instruction provided in Kindergarten was not a strong predictor of children’s immediate and later science achievement (Sakes et al., 2011).

**Children’s Experience with Science in the Preschool Classroom**

Children are able to understand and learn about science, but what the children are exposed to at school depends on the teacher. A teacher is responsible for setting up the prepared environment for the children. This environment helps teachers decide what content to which children are exposed. A review of past studies suggests that no science activities (planned or unplanned) are likely to occur in the preschool classroom. Upon observation, teachers have been found to spend most of their time in other parts of the classroom with the least amount of time spent in the science area (Nayfeld, Brenneman, & Gelman, 2011; Greenfield et al., 2009). Currently, preschool children’s experience with science varies from classroom to classroom, as preschools and teachers deal with a mixture of challenges that influence the teachers’ ability to teach science lessons effectively. Some of the challenges that teachers face include: the teacher’s own personal attitudes and beliefs, pressure from schools to focus more on literacy, and a lack of utilizing curriculum that includes science lessons.

**Teacher attitudes.** Various studies have focused on using teacher interviews to reveal possible reasons for the shortage of science instruction. Maier, Greenfield, & Bulotsky (2013) created a questionnaire, based on a 5-point likert scale, to measure early childhood teachers’ attitudes and beliefs toward teaching science. A total of 507 teachers completed the questionnaire and reported a range of attitudes and beliefs towards teaching science. The questionnaire included questions on the teachers comfort for teaching science, the benefit of science for children, and challenges when teaching science. Overall the teachers believed that children can benefit from learning science. The teacher’s attitudes about science varied depending on what type of science (life, earth, physical) was being questioned. The results showed that teachers felt more comfortable teaching life and earth science than physical science. (Maier, Greenfield, & Bulotsky, 2013).
In another investigation of teacher attitudes about science in preschool, Greenfield et al., (2009) arranged group meetings with teachers from 12 different Head Start preschools. The researchers invited the teachers to discuss any concerns they had about teaching science, problems they ran into, and achievements they have had. One common finding that emerged from the group sessions included many of the teachers reported feeling uncomfortable about their own knowledge of science. This lack of knowledge leads to feelings of discomfort related to using science materials and teaching about science in general (Greenfield et al., 2009).

Pressure to emphasize non-science learning experiences. The teachers in Greenfield et al. (2009) study also claimed to have difficulty finding enough time to provide children with learning experiences in all the domains required by the Head Start program. Specifically, teachers felt a great amount of pressure to focus on language and literacy, which challenged them even more to find time to cover all the areas they were supposed to (Greenfield et al., 2009). Results from Maier, Greenfield, & Bulotsky (2013) questionnaire also found teachers felt some of the challenges to teaching science included not having access to the right materials and not having enough time in the day. Nayfield, Brenneman, and Gelman (2011) report that even if science materials and discovery areas exist in the classroom they are often neglected by teachers and students; as a result, science learning rarely occurs.

Sample classroom. The Head Start program offers a sample classroom to observe in relation to the science curriculum offered. This program has eight readiness domains, which act as standards for the program and include creative arts, language and literacy, math, motor development, physical health, science, approaches to learning, and social and emotional development. A study by Greenfield et al. (2009) compared how the science domain ranked when compared to the other seven designated Head Start readiness domains. The sample consisted of two years of data; the first sample included 2032 children and the second sample included 2927. The domains, which tracked a child’s attainment and understanding of various skills, were measured at the beginning and end of the school year. Throughout
the year, teachers observed and recorded each child’s attainment of specific skills within each of the eight domain areas on a web-based system. The assessment scores showed that science was the only domain that was significantly lower than the other seven domains, at both the beginning and the end of the school year (Greenfield et al, 2009). This study reinforces other studies findings that science is not as important as other academic topics in the preschool classroom.

**Potential for science learning in preschool.** Efforts to infuse preschool classrooms with science learning opportunities yield intriguing results. For example, Nayfield, Brenneman, and Gelman (2011) conducted a three-step study in six urban preschool classrooms to see if a simple intervention of introducing a balance scale into classroom group activities could increase interest in the science area. Three of the preschool classrooms were experimental and the other three were control rooms. The sample consisted of 42 students in each of the classrooms. Phase 1 of the study included collecting data on how much time the children spent in the science area and what their prior knowledge of a balance scale was. The second phase included the intervention, in which the researchers came into the experimental classrooms and gave a lesson on how to use the balance scale. Phase three occurred 20-25 days later and included a second set of observations and a second set of interviews about the scale to observe any changes that may have occurred. An analysis was done on the children’s presence in the science area. It was conducted by calculating the number of children present in the science area during each minute the area was occupied and referred to as child-minutes. The number of child-minutes increased from 76 child-minutes before the intervention to 638 child-minutes after the intervention. There was no change seen in the control classroom (Nayfield, Brenneman, & Gelman, 2011). Intervention and instruction on the materials increased the children’s interest in science as shown by the increased use of the area during free choice time.
Preschool science programs. Though spontaneous science activities can increase science interest in the classroom, even greater gains can be found when classrooms implement a coherent science based curriculum.

ScienceStart! ScienceStart! uses science as the base for learning about all the subject areas, a description of the program includes,

ScienceStart! Takes preschoolers’ fascination with learning about the everyday world as the starting point for planned/structured activities that are designed to foster critically important aspects of development in the area of language, early literacy, attention regulation, planning, and problem solving. The sustained, coherent investigations of natural phenomena (for example, the study of color and light spans 10-14 weeks) leads to a rich knowledge base that can support higher order cognitive skills such as generalizing, drawing deductive and inductive inferences, making comparisons, and posing/testing hypotheses (French, 2004, p. 139).

Because science is engaging for children and can hold their interest for extended periods of time, ScienceStart! was designed to use science as a way of engaging children in literacy activities. Teachers who have implemented it claim that their students are more engaged, participate more, and seem to absorb more information. Quantitative evidence that supports teacher impressions is also available. Specifically, children completed the Peabody Picture Vocabulary Test (PPVT) at the beginning and end of the year. The test was given to 6 cohorts totaling 162 children. Sixty-one of the children attended ScienceStart! classes while the other 101 children were in the control group. The children using the ScienceStart! curriculum had greater vocabulary gains and science understanding than the children who were not using it (French, 2004). The curriculum has shown that a structured approach to science instruction is possible and can lead not only to greater knowledge about the world, but also development in language and literacy (French 2004). Previously it was noted that one of the reasons
teachers do not teach much science is they feel pressured to focus on promoting literacy and language skills. The ScienceStart! curriculum not only allows for development in language and literacy, but also allows for increased science instruction (French, 2004; Grenfield et al., 2009).

**Early Childhood Hands-On Science.** Early Childhood Hands-On Science (ECHOS) is a science program that has been shown to help teachers include science in their instruction. ECHOS was developed by the Miami Science Museum and is a hybrid curriculum series. The program “embraces direct instruction as fundamental to knowledge building, coupled with guided discovery and inquiry-based science exploration and experiences” (Greenfield et al., 2009, p. 251). The goal of the ECHOS program is to assist the teachers in improving their confidence in teaching science and to help them to adjust their schedules to include time for science. Eighteen teachers agreed to test the program. The teachers were required to attend professional development meetings to learn how to implement the program in their classrooms. The children in both the control and experimental classes were tested at the beginning and the end of the year. Children’s scores in the ECHOS classrooms were significantly higher at the end of the school year than the control classes in all Head Start domains. The results of this program show that teacher training in science instruction can have a positive impact on the preschool classroom in all academic areas (Greenfield et al., 2009).

**Preschool Pathways to Science.** Preschool Pathways to Science (PrePS) is another science curriculum that was developed to support preschool children in the realm of abstract thought (Gelman & Brenneman, 2004). PrePS is the result of a collaboration of preschool teachers, directors, and cognitive researchers. Research formed a starting place for the content and research still continues to drive new practices in the curriculum.

The PrePS program is not a prescribed list of topics (with related activities) that teachers should teach to children. Rather, it is an approach to classroom planning that allows teachers, staff,
and children to explore a given concept through many, varied experiences, that nonetheless are connected by an underlying concept or question (Gelman & Brenneman, 2004, p. 155).

PrePs focuses on doing and recording science rather than simply presenting a collection of facts. Teachers who have participated in PrePS have found that they can not only teach science, but having more responsibility for the development of the curriculum has helped to reignite their passion for teaching (Gelman & Brenneman, 2004). Empirical data regarding the effectiveness of this approach in supporting children’s learning and teachers’ attitudes is not yet available.

Both educators and researchers continue to explore preschool children’s classroom-based science experiences. Further research is needed to see if addressing the teachers personal attitudes and beliefs, pressure to focus more on literacy, and a lack of utilizing science curriculum will be enough to increase science instruction (French, 2004; Greenfield et al., 2009; Gelman & Brenneman, 2004).

**Children’s Experience with Science within Parent-Child Interaction**

Although one context for science learning is within preschool classrooms, science learning occurs outside the classroom as well. Research has started to examine the types of science activities that children engage in outside of the classroom, as well as how adults engage in those activities with children. Activities with parents may include going to a museum, reading a book, having meaningful conversations, and other out-of-school activities (Korpan, Bisanz, Bisanz, Boehme, & Lynch, 1997; Stylianides & Stylianides, 2011).

Stylianides and Stylianides (2011) looked into how often parents and children engaged together in a set of related activities. The study included a sample of 10,000 children from the Early Childhood Longitudinal Study Kindergarten Cohort (ECLS-K). Using a likert scale, ranging from 1(not at all) to 4(everyday), parents rated the frequency in which they participated in certain activities. The activities were comprised of how often parents: read to their child, tell their child stories, help their child do art,
build things with their child, teach their child about nature, play games with their child, and do sports with their child. The study suggests that children that are able to engage in more of these parent-child interactions tended to have higher academic achievement than their peers (Stylianides & Stylianides, 2011).

Korpan et al. (1997) extended the finding that parent-child engagement in activities has a positive effect on a child’s development by investigating family science activities. The researchers interviewed parents to get a sense of the science activities in which children participate in their homes and in the community. The study consisted of 29 kindergartners and 35 fifth and sixth graders. Parents were interviewed in their homes. Information from the interviews was collected to determine the books children read, the television shows they watch, and other activities related to scientific concepts. The interviews provided insights to how often children read or watch programs about science, the importance of parents as facilitators, and the types of question asking/answering activities that occurred at home. The study clearly illustrates that there are many science-related learning opportunities outside the home which should not be ignored (Kopan et al., 1997).

Although Korpan et al. (1997) documented that science learning opportunities exist in the home environment; their work does not reveal how those experiences unfold. Tenenbaum and Callanan (2011) addressed this issue by investigating parent-child conversations related to science, both at home and at a children’s museum. The participants included 40 parents and their children. All of the families were of Mexican-descent and very few had ever been to a museum before. The first part of the study included video-taping families at a children’s museum. About 2.8 months after the museum visit, the researchers also made a home visit where the families engaged in two tasks that the researchers brought. The researchers coded each of the parent-child conversations for four types of talk including: using prior knowledge, providing casual explanations, explaining scientific principles, and encouraging predictions. Findings showed that families engaged children in science conversations. Results also
suggested that rich conversations between adults and children lend themselves to the development of children’s scientific literacy in some contexts (Tenenbaum & Callanan, 2011).

**Home-School Connections: Bridging Across Everyday Learning Settings**

Researchers and professional organizations have highlighted the importance of family involvement in children’s school achievement (Barbour, 1998; Gennaro & Lawrnz, 1992; Floyd & Vernon-Dotson, 2009). Family involvement, however, should not be limited to parents volunteering at school (Barbour, 1998). Evidence shows that school programs aimed at reinforcing the importance of parents as educators, and homes as learning environments, have great potential for influencing children’s learning (Barbour, 1998; Floyd & Vernon-Dotson, 2009). One strategy to encourage family participation in children’s learning includes the use of take-home bags. The materials in such bags encourage parents and children to read books and do related activities in an informal fashion (Barbour, 1998; Gennaro & Lawrnz, 1992; Zeece & Wallace, 2009; Floyd & Vernon-Dotson, 2009).

Barbour (1998) looked at one school-home program that was created and tested by three teachers in San Antonio, Texas. The teachers initiated a family literacy program that included take-home bags (Barbour, 1998). The program consisted of 109 “B.E.A.R. (Be Excited About Reading) bags” that were taken home and rotated between 97 Prekindergarten and Kindergarten children. The bags consisted of 4 children’s books that shared a theme, as well as one or two activities that extended the theme. Teachers implemented the bags for two months within the classroom and each child could keep a bag for approximately 1 week. At the end of the two months, the teachers sent home surveys to collect feedback from parents. The teachers found parents’ responses to be overwhelmingly positive. The teachers also found that the project not only allowed all families to become involved in their children’s learning, but parental attitudes and behaviors about the importance of their role as educators became more positive as well. Whereas parents originally claimed that they rarely made time to read to their child, they now expressed that they were making time to do so (Barbour, 1998).
Another study field tested take-home science kits at an elementary school in the Midwest for two years (Gennaro & Lawrnz, 1992). Researchers created twenty different take-home science kits for first through fourth graders. The inquiry based activities attempted to encourage discussion between adults and children. A science kit included hands-on materials, as well as an activity booklet containing instruction for 3-5 activities. Students checked out the kits for two nights or over the weekend. During the first year, the study consisted of 78 first-graders and 74 third-graders. During the second year, the study consisted of 73 second-graders and 78 fourth-graders. At the end of each academic year, parents completed a questionnaire about their thoughts and responses to the science kits. Researchers also asked each of the students questions about the science kits. The responses from the questionnaire were overwhelmingly positive. The results showed that most of the first (78%), second (89%), and third (81%) graders wanted to do more kits. The researchers also found that 88% of the parents claimed that it was enjoyable to learn together with their children and 90% claimed they would recommend these kits to their friends. Eighty-one percent of parents also believed that their children had become more interested in science as a result of having these take-home science kits. Overall the program was viewed as effective by the children, their parents, their teachers, and the administration at the school (Gennaro & Lawrnz, 1992).

Further Exploration
Research has shown that science is an important topic for preschool-aged children to learn and experience. Several programs exist to help provide a framework for science learning within preschool classrooms. In addition, researchers have identified variability in whether and how parents support science learning at home. Research also shows that creating family/school partnerships promote elementary-aged children’s learning. Barbour (1998) and Gennaro and Lawrnz (1992), for example, presented the idea of creating take-home bags or kits designed to increase parental involvement in their student’s education; the results showed positive outcomes in both studies. It is important, however, to
consider that parents may adopt a learning agenda once their child enters grade school that they don’t have for younger children.

This senior project capitalizes on Barbour (1998) and Gennaro and Lawrnz (1992) ideas by creating a new type of take-home science backpack geared toward preschoolers. I created Science Literacy Connection (SLiC) backpacks for preschoolers. In addition, I field-tested one of the backpacks. My goal in developing this take-home science backpack program was to offer preschoolers and their families a fun and engaging way to explore science. This creative project serves as initial attempt to increase the amount of science preschoolers are exposed to, while also increasing parent-child science related interactions.
CHAPTER 3

Method

In this senior project, I created plans for three different take home science backpacks for preschool aged children to use with parents. The purpose of the backpacks was to promote parent-child engagement and conversations in and about science. The goal was to increase the number of experiences children have with science in a positive and educational way. This senior project consisted of two phases. The first phase was to develop the backpacks and the second phase was to pilot one of the backpacks for feedback from parents.

Phase 1: Development of SLiC backpacks

The SLiC backpacks are based off of similar bags created for 3rd, 4th, and 5th graders by three Chemistry professors at Cal Poly- San Luis Obispo. I assisted in the making of these existing bags and used them as a template for creating the following Preschool SLiC backpacks.

Procedure. I choose the backpack themes (sky, bugs, and food) based on participant observation of 28 children’s common interests during outside time. The children ranged in ages from 2.5-6 years old; all were students in either the 2.5-4 or the 3-6 year old classrooms at the Children’s Montessori School in San Luis Obispo. This sample was a sample of convenience as I was working as a before and after school teacher at the time.

After determining the general themes, I explored as many children’s literature books as I could find related to the science themes chosen. First, I narrowed down the books by reading various reviews posted on the internet. As I narrowed down books that I liked, I also narrowed down specific themes (cloud types, food chains, and acids and bases) for the backpacks based on the children’s literature selection that was available. Next, I either bought or checked the books out of the library in order to examine the text and illustrations. The final books chosen for the backpacks displayed engaging illustrations as well as scientifically correct/ age appropriate text. A book on Acids and Bases posed an
extra problem. I liked the content in one book, but was unhappy with a background story that portrayed children in a negative light. I fixed this by scanning all the pages, removing some of the pages completely, and replacing the negative features with positive or neutral ones via Photoshop.

Once I decided on the books, my next step included finding activities that not only supported the content covered in the book, but expanded on it as well. When looking for activities, I consulted the internet, science activity books, and science professors specializing in education. I then tested various activities I thought might work and chose the ones I believed were simple to do, required few materials, were engaging, and supported learning of the relevant content.

The last step in creating the SLiC backpacks was to write the welcome sheet and activity book. I based the welcome sheet and activity books off the 3rd, 4th, and 5th grade bags I had assisted in creating. The activity book included instructions for each activity in the backpack, as well as suggested questions. I decided to also include extra information about the topics for the parents in case the child’s interest surpassed the content in the backpack.

The resulting plan was that each backpack would include: a Welcome Sheet, two children’s literature books, an activity book, all the materials for the activities, and a journal to record their experiences.

**Phase 2: Field Testing**

After developing the SLiC backpacks, the Cloud Types backpack went through a pilot-testing process so that I could begin getting feedback on the possible outcomes of sending family science backpacks home.

**Participants.** Three children ranging in age from 3-5 years participated in the field-testing. For the first observation, one 5-year-old boy and the director of The Cal Poly Preschool Learning Lab participated. This was a sample of convenience given that I personally knew the director and was a student at Cal Poly. Similarly, for the second observation, one 3-year-old girl and a student-assistant in
The Cal Poly Preschool Learning Lab participated. Finally, for the third and last pilot test, one 5-year-old boy and his family participated in the study by taking the backpack home. This child was from the Montessori Children’s School in San Luis Obispo and also reflected a sample of convenience as I was working at the school at the time.

**Materials.** Pilot testing involved the use of a prototype of the SLiC Backpack- Name that Cloud. In addition, I developed a questionnaire (see Appendix D) consisting of 11 questions to collect feedback on the overall effectiveness of the SLiC backpack. The questionnaire included both forced choice and open-ended items. For example, some items sought information on the child’s experience with the activities, whereas others inquired about the adult/parent’s experience with the materials. A question assessing the clarity of instructions was also asked.

**Procedure.** The pilot testing occurred in 3 contexts. First, I observed the director at The Cal Poly Preschool Learning Lab conduct the activities in the cloud backpack with a 5-year-old child. During the observation, I sat off to the side and took field notes. When the dyad had completed all the activities in the backpack, I sat down with the head teacher to discuss her experience with the backpack. I asked questions such as: were the instructions easy to follow? And, what is something you would change about the backpack? From this observation and interview, I changed activities in the backpack that did not go as smoothly as planned.

Once I was done revising the backpack, I went back to The Cal Poly Preschool Learning Lab to test the backpack again with another dyad. This time I recruited a student assistant, who had never seen the SLiC backpack, to conduct the activities in the Name that Cloud backpack with a 3-year-old child. This was done to give variability to the sample on how different people interact with the backpack. After briefly explaining my senior project to the student-assistant, I handed her the SLiC backpack and let her look it over. I then sat off to the side and took field notes as the student-assistant
and child interacted with the backpack. I took field notes on what activities were completed, if the student-assistant and child had an easy or hard time carrying out the activity, and I also took notes on comments the child made throughout the activity. After the dyad was done exploring and completing activities from the backpack, I sat down with the student-assistant to discuss her experience with the backpack. I asked her questions from the parent questionnaire and discussed her overall thoughts about the backpack.

After the second field-testing observation, I took the SLiC Backpack to the Montessori Children’s School and invited a child in the preschool class to take the backpack home. The family was given the allotted time of a week to explore and complete all the activities in the bag. A parent questionnaire was put in the backpack to gather feedback about the child’s and family’s experience with the backpack.
CHAPTER 4

Results

Results are discussed in four sections. The first section includes a description of all of the items that each SLiC backpack contains. The second section describes the first pilot observation and how the findings from this observation led to changes in the SLiC backpack tested. The third section examines the second pilot observation. The fourth section analyzes the parent questionnaire from the take-home field testing experience.

Final SLiC Backpacks

This project resulted in designs for three SLiC backpacks, with one backpack actually being physically created for use in pilot testing. The backpacks were nylon drawstring backpacks with the SLiC logo stamped on the front of them. The colors of the backpacks included blue, green, and red. Each of the backpacks included a bag tag that indicated the theme of each backpack. The general items incorporated inside of each backpack included a welcome sheet, supply list, two children’s literature books, activity booklet, materials for the activities and a sharing journal. The below sections describe in detail each of the SLiC backpacks in their final form.

"Name that Cloud" backpack. The “Name that Cloud” backpack (see Appendix B) consisted of 7 parts aimed at expanding children’s knowledge about different cloud types. The cloud backpack included two books. The first book, *Shapes in the Sky: A Book About Clouds* focused on what makes a cloud and the different types of clouds. The second book, *What is Science?* focused on exposing children to the many different fields of science. An activity book was also created that gave additional information to parents about clouds as well as instructions and suggested questions for the activities included in the backpack. The two activities in the backpack included the Weather Window and Cloud in a Jar. The Weather Window is a frame with real pictures of clouds and their corresponding name around the outside. It allows children the chance to identify clouds that are currently in the sky. It also
encourages children to predict what the weather may be based on the descriptions included on the back of the Weather Window. The Cloud in a Jar activity allowed children the opportunity to make their own cloud. The last item included in the backpack was a Sharing Journal that allowed parents and children to share their experiences with other families that use the backpack.

“What’s on the Menu?” backpack. The “What’s on the Menu?” backpack (see Appendix C) consisted of 6 parts aimed at expanding the child’s knowledge about food chains. The Food Chain Backpack contained two books. The first book, *Secrets of the Garden* focused on the food chains and food webs that can be found in a person’s backyard. The second book, *Scientists Ask Questions* focused on what makes a scientist. An activity book was created and included in the backpack. It gave additional information to parents about local animals and insects as well as instructions and suggested questions for the activities included in the backpack. The two activities in the backpack included the gobble-up food chain activity and bugs up close activity. The gobble-up food chain activity used nesting blocks to create a food chain using local animals by stacking the series of consumers on top of what they eat. Using nest cups allowed for a control of error as a pill bug (smaller cup) is not able to gobble a red-tailed hawk (larger cup). The bugs up close activity allows children to take a closer look at the insects in their backyard, that make up part of a food chain, by using a magnifying bug viewer. The last item included in the backpack was a Sharing Journal that allowed parents and children to share their experiences with other families that use the backpack.

“pH Fun for Everyone” backpack. The “pH Fun for Everyone” backpack (see Appendix D) consisted of 6 parts aimed at expanding the child’s knowledge about acids and bases. The Acids and Bases backpack contained two books. The first book, *What Can I Do?* focused on what Acids and Bases are and different ways to discover if something is an acid or a base. The second book, *What is a Scientist?* focused on what a scientist does and how even children can be scientists. An activity book
was created and included in the backpack. It gave additional information to parents about how to make their own litmus paper as well as instructions and suggested questions for the activities included in the backpack. The two activities in the backpack included liquid color and mystery strips. The liquid color activity includes a bottle of phenyl red, which is a pH indicator, and encourages children to discover if the liquids or powders in their house are acids or bases. The mystery strips activity includes litmus paper, which is another pH indicator, and encourages children to further explore the different acids and bases found in their home. The last item included in the backpack was a Sharing Journal that allowed parents and children to share their experiences with other families that use the backpack.

Pilot Test #1: Preschool Director-Child Observation

After the backpacks were completed, I piloted one backpack, Name that Cloud, to observe how effective the instructions and materials were when used by children. The results from the first observation provided a baseline about the effectiveness of the activities and instructions in the Name that Cloud backpack.

My observation of the Cal Poly Preschool Learning Lab Director and her interaction with a 5-year-old boy started outside on a bench. The child began by taking all the items out of the backpack. While extracting all the items the director informed the boy what the name of each item was. The weather window was the first item the child picked-up and investigated. Scaffolding provided by the director was needed for the child to understand how to use the weather window properly, as his first instinct was to stick his face in the window. The director did this by extended the child’s arm that was holding the window, framing a cloud in the sky, and asking “what does that cloud look like?” Once the child understood the intended use, he was interested in matching all the different clouds in the sky to a picture on the weather window.
After investigating what clouds were in the sky, the director picked up the *What is Science?* book and began to read. The director read just the text that was in the book, but participated in conversation outside of the text if the child commented on something. Throughout the book the 5 year old made comments about the different pages. One comment “that’s a long train” was made after being read a page on how science includes trains and planes. Overall the book was engaging enough to hold the child’s attention, as shown by him listening to the story, looking at every page, and commenting on interesting items he saw such as the train. Other children that overheard the story being read also came over to see the pictures and listen to the rest of the story.

After the book was finished the 5 year old handed the director the *Shapes in the Sky* book. The director seemed to use more non-immediate talk while reading this book to the child. She did this by connecting what was being read to the child’s current world as well as asking questions to challenge the child’s critical thinking ability. One example of this is after the director finished reading a page about cumulus clouds, she asked the boy “Are there any clouds in our sky that look like cumulus clouds?” The child during this time not only listened to the story, but also responded to the director’s question by trying to match the cloud name to a picture on the weather window. The child discovered while doing this that there are many different types of cumulus clouds. After discovering this, the child asked for the name of each of the clouds on the Weather Window. This vocabulary learning opportunity was not one of my original intentions in including the Weather Window, but it appeared to excite the child as shown by his increased amount of curiosity into what the names are for each of the cloud types. The child’s enthusiasm and continued exploration using the weather window gave me confidence in my decision to include that activity in the backpack. The interaction also revealed, however, the need to include information on how to pronounce the cloud names. This was evident when the director asked for help as she struggled to pronounce some of the different cloud names.
While reading the book the director also used non-immediate reading techniques to start a comparison discussion. The discussion included the director and child comparing the color differences between the illustrations in the book and the real pictures provided on the Weather Window. The discussions did not deter the director and child to also seek to try and find the different clouds they were reading about above them in the sky. The child enjoyed this activity as shown by him jumping up off the bench while holding the Weather Window up towards the sky to try to see if the cloud they read about was in the sky at that time. After they finished reading *Shapes in the Sky*, the director asked “would you like to make a cloud?” The child agreed and they headed inside. The pair attempted to follow the directions for the Cloud in a Jar activity, but encountered difficulty in deciding how hot the water should be and how fast they needed to complete the steps. As a result, they were unable to create a cloud in the jar. They tried 3 different times, each time trying a new method suggested by the child. Some of the suggestions made were to put paint in the water to make the cloud a different color, do the procedure faster, and go to a dark place. After the first attempt, the director tried to do the procedure faster like the child suggested, but they were still unable to make a cloud. The third time they attempted to make a cloud in the jar, the director added food coloring instead of paint to the water, but they still were unable to create a cloud. Ultimately, although they were not able to create a cloud any of the times, they did engage in scientific processes of creating a hypothesis, testing it, changing their hypothesis a little, and retesting it again.

As a result of this observation, as well as the results of the post-activity interview I had with the director, I decided to make some changes to the Name that Cloud backpack. The first change I made was inserting a Cloud Name pronunciation key into the Parent Background Information in the activity book. I choose to do this based on my observation of the director struggling to pronounce some of the cloud names such as “cumulonimbus.” The other change that was made was to revise the Cloud in a Jar activity and rewrite the directions. I choose to do this because the activity did not work at all during the
observation and it is important that each activity work smoothly and easily. I completed various tests on different methods of how to make a Cloud in a Jar. Eventually, I found a new set of directions that seemed to be more effective.

**Pilot Test #2: Student Assistant-Child Observation**

The second observation included a student-assistant and a 3 year old child from The Cal Poly Preschool Learning Lab. As in the first observation, the dyad started to explore the backpack while sitting outside on a bench. The student-assistant introduced the activity by asking the child, “what do you know about clouds?” The student assistant then asked, “Can you see clouds now?” The child looked up at the sky and then nodded her head to indicate that she could. The student-assistant then took out the *Shapes in the Sky* book and began to read, stopping here and there to ask questions such as, “can you say cumulus?” or, “Does it look like we have stratus clouds above us now?” The child responded to the student-assistant’s questions as well as commented on the different pages by describing when she had seen that cloud before. The book held the child’s attention and seemed to encourage a scientific-based conversation about clouds.

After the student-assistant finished the book, she took out the weather window. The student-assistant held the weather window up towards the sky and asked, “which of these clouds looks like one of these (pointing to the pictures on the weather window)?” The child responded each time by saying “that one (pointing to a picture on the weather window).” After the third time the student-assistant asked this type of question, the child started wandering away to participate in a different activity. To reengage her, the student-assistant asked the child quickly if she would like to draw a cloud in the Cloud Journal, the child came over and drew her interpretation of a cloud (Appendix E). After the child finished drawing she did not want to make a cloud in a jar, which ended the observation. As the backpack was meant to be taken home for a week, I did not view it as a problem that the 3 year old was unable to stay engaged with the whole bag in one setting.
After the observation I sat down and interviewed the student-assistant using my parent questionnaire. The student-assistant believed that the SLiC backpack was engaging for both herself and the child, although she believed it was a lot of content. Her favorite activity was the weather window because it allowed the child to make connections to the book they had read. The student-assistant also felt that the child as well as herself walked away learning at least one new thing about clouds. Based on this observation, I did not make any changes to the backpack.

**Pilot Test #3: Take Home Feedback**

The third pilot test included a 5-year-old boy from the Montessori Children’s School taking the Name that Cloud backpack home to complete with his family. His family included a mother, father, and an older sister that was 9-years-old. When I picked up the backpack at the Montessori Children’s school I asked the boy if he enjoyed the backpack. He responded by saying, “yeah! Do you want to know what are two favorite activities were?” I nodded my head and the boy proceeded to tell me that he and his family enjoyed looking at the clouds and the strainer activity. After I finished talking to the 5-year-old about his experience with the backpack, he told me where he had left the backpack for me to pick-up.

The first observation I made when I received the backpack back was the condition of the backpack and all the materials. The backpack was starting to get two small holes in the fabric where the corners of one of the books had been pushing against it. The books showed a little wear from being read. This was made known by the spine being creased and some of the page corners being turned up. The last observation that could be made about the returned backpack was that the jar and the strainer were missing as the family had forgotten to return the items to the backpack.

After looking at the condition of the backpack I took a closer look at the questionnaire the parents filled out to describe their overall experience with the activities and books in the backpack. The family indicated they had participated in all of the activities except for writing in the sharing journal.
Overall, the family felt that the backpack was engaging. This was shown by the parents and child rating their engagement as a four on a scale of one to five, one being not engaged and five being very engaged. They indicated that their favorite activity was looking at the clouds with the Weather Window and their least favorite activity was the Cloud in a Jar activity. The parents and child each felt they had learned something from this experience. When asked, “What might your child have learned?” the parents responded by writing “different names of clouds.” The parents also felt that the activity instructions were easy and clear to follow. No extra suggestions on how to improve the backpack were given.
Discussion and Conclusion

The importance of this project is that it provides a potential approach to increasing the amount of science experienced by preschoolers. The approach entailed creating three different take-home family science backpacks that could bridge the gap between science learning happening at school and the science learning opportunities that can happen at home. Field-tests completed on the “Name that Cloud” SLiC backpack suggested that children and adults positively engaged in science-related activities while exploring the backpack contents. As a result, I felt that the “Name that Cloud” SLiC backpack achieved what it was designed to do, which was to increase preschool children’s exposure to science as well as encourage parent-child interactions. This was evident both in my field observations, and in the questionnaire from the home trial in which the parent wrote that they read each of the books and completed each of the activities. The parents also reported that the child was engaged in the activities.

Preschool Children’s Reactions to Science

The children who participated in the observational based field-testing displayed feelings of curiosity as they explored the contents of the backpack and completed the various activities. A natural curiosity was shown in the first pilot-test when the boy took out the Weather Window and examined it before sticking his face in the frame. Once he learned how to use the window correctly, he further explored the sky around him. During this field-test, however, the cloud in a jar activity did not work. This experience, however, did not discourage the child from science; instead his curiosity seemed to heighten as he attempted to solve what. As he did so, he and the director tried some ideas out, resulting in even higher levels of apparent engagement. As seen by this example, the child’s interest in science is evident. The curiosity and engagement expressed by the child supports previous studies on children’s interest into the world around them (French, 2004; Nayfield, Brenneman, & Gelman, 2011;
Eshach & Fried, 2005). Similarly, field notes from the first pilot-test revealed that the 5-year-old boy asked questions to find out the different clouds names, which also supports past findings that children ask questions about the world around them (Callanan & Oakes, 1992).

Beyond the child’s engagement, each adult that participated in the pilot-testing believed that the child with whom they completed the activities, had learned something new from the science experience. The adults expressed that they felt the science activities were presented in an understandable manner that is not too challenging for preschool children. These feelings support researcher’s beliefs that children are able to learn about and understand science topics (Eshach & Fried, 2005; Cowie & Otrel-Cass, 2011; Nayfield, Brenneman, & Gelman, 2011; Siry, Ziegler, & Max, 2011).

**Adult-Child Interactions**

The goals in creating family science backpacks was to both increase the amount of science to which preschool children are exposed, as well as increase parent-child interactions. The backpacks all required adult assistance as most preschoolers are not able to read the children’s literature or instructions for the activities. In support of this, research shows that rich conversations leads to an increase in the development of a child’s science literacy as well as parental involvement increases a child’s academic achievement (Floyd & Vernon-Dotson, 2009; Tenenbaum & Callanan, 2011).

Unfortunately, the questionnaire did not capture how the parent and child interacted during the take-home pilot-test. The only indicator showing that parent-child interaction occurred is that the parents checked off that they had read both the books as well as completed the activities included in the backpack.

Results supporting adult-child interactions can, however, be drawn from the observations in the first and second pilot test. The director’s interaction with the 5-year-old seemed to foster a lot of interest in the science material as well as made the overall experience enjoyable. This was done by allowing the child to pick and choose in which order the materials in the backpack would be used as well
as asking questions that fostered critical thinking in the subject at hand. The student-assistant’s interaction with the 3-year-old revealed a different approach to interacting with children. Unlike the easy going approach the director took, the student-assistant had pre-determined the order in which the materials would be presented to the child. Another difference is that the child was forced to take on more of an observation role rather than exploring role. This was shown by the student-assistant holding the weather window up and allowing the child to just look through it. This approach resulted in a different interaction than the previous field test. The 3-year-old appeared to be engaged when the activity began and then she slowly lost interest until she finally walked away. Her originally engagement shows that the 3-year-old was interested in learning about science. Her loss of interest could be connected to her age or it could be connected to her lack of personal investment in the activities. These observations bring to light that people interact differently with children and this includes how parents interact with their child. Research is still determining whether or not controlling an investigation hinders a child’s curiosity, but social learning theory suggests that what a parent does before and after a child has produced a curiosity response can influence the frequency of curiosity (Bandura & Walter, 1963 as cited by Saxe & Stollak, 1971). In one study, Saxe and Stollak’s (1971) observed the mother-child interaction, the child’s curiosity, and play behavior among 14 different first-grade boys and their mothers. One finding indicated that curiosity expressed toward an object by one person is related to the amount of curiosity expressed toward that object by another person. It was unclear from the data though as to whether the parent influenced the child or the child influenced the parent.

**Backpack Survival**

After receiving the “Name that Cloud” SLiC backpack from the pilot test family, I noticed some things to plan for if these materials do get implemented into a classroom. First, it would be good to invest in sturdier backpacks. The “Name that Cloud” backpack was used in two observational based pilot-testing scenarios and was taken home once with a child and it was starting to get holes in it. If
these backpacks are to be further tested they will need to last longer than three uses. Another thing to keep in mind is that sometimes not all the materials will make it back. When I opened up the “Name that Cloud” SLiC backpack I discovered that both the jar and the strainer had not been returned. If implemented on a wider scale it would be important to set up a return policy. Besides the backpack, the materials that were returned came back in good condition.

Limitations
Despite these initial pilot efforts, it is premature to offer unequivocal support for this approach to fostering home-school science learning opportunities for preschoolers. One concern is that I created three backpacks, but only one of the three went through field-testing. A related issue is that the “Name that Cloud” SLiC backpack was only tested by a relatively small number of subjects. Further, out of the three tests that were completed, only one consisted of the intended context of use in which the backpack is taken home with a child. My project would have benefitted from having a more detailed questionnaire, as the current one supplied a very limited amount of data and feedback. Another limitation included altering the “pH Fun for Everyone” book, *What Can I Do?* without receiving permission from the author. Additionally, the backpacks attempt to assist parents in fostering curiosity and inquiry based learning by giving them suggested questions, but ultimately every child will have a different parent-child interaction as well as a different experience with the SLiC backpacks. A final limitation is that the backpacks are currently only in one language, which limits the families with whom the backpacks can go home. Taken together, these limitations suggest that more research and development is needed before broad distribution of these materials is possible.

Future Research
Future research should include piloting the “What’s on the Menu?” and “pH Fun for Everyone” SLiC backpacks that I created. A greater depth of information may be obtained by including a larger and more diverse sample of preschool children and families. A larger sample size would allow me to get a
better idea of whether or not implementing SLiC backpacks in preschools will have a positive result on science learning. Another possible improvement to the study would be to include video observations at the home. This would help to elucidate how parents are engaging with their child at home as well as the families overall engagement with the backpack.

**Implications**

This project sought and has the potential to empower preschool children and families to build the foundations for a lifelong enjoyment of science. Science Literacy Connection Backpacks (SLiC) can become an effective strategy for individual teachers or schools to involve families in supporting their children’s science education. Evidenced by, the interest and engagement levels expressed by children who participated in the pilot tests. If given the chance these backpacks may ultimately lead to enhanced science educational outcomes within and outside classrooms. Through the establishment of effective family–school partnerships, teachers can foster family participation in a manner that reflects student achievement as a clear priority.

*If we want to foster a love of learning in our children we must follow their interests and passions to achieve this.*
References


Appendix A

Questionnaire

These bags are still in development. I would really appreciate any feedback you are willing to give. Thank You.

1. How engaged were you with the SLiC bag?

   1  2  3  4  5
   Not Engaged
   Very Engaged

2. How engaged was your child with the SLiC bag?

   1  2  3  4  5
   Not Engaged
   Very Engaged

3. Which book(s) did you read?

   ___ Both
   ___ Shapes in the Sky
   ___ What is Science?

4. Did you try the Weather Window? (Circle One)  Yes  No

5. Did you try the Cloud in a Jar? (Circle One)  Yes  No

6. Did you write in the Cloud Journal? (Circle One)  Yes  No

7. What was your favorite activity? Why?
8. What was your least favorite activity? Why?

9. Do you feel you learned anything from this experience? (Circle One)
   Yes  No

10. Do you feel your child learned anything from this experience (Circle One)
    Yes  No

11. If yes, What might your child have learned? If no, Why not?

12. Were the activity book instructions easy and clear to follow? (Circle one)
    Yes  No

   *If no, what suggestions do you have?*
Appendix B

Name that Cloud Backpack


WELCOME CHILDREN AND PARENTS:

In this Family Science Backpack you will find a book, activities, and ideas for learning about science in a fun and interesting way! The activities are designed for you and your child to explore science together.

The backpack is designed to be taken home for approximately one week and returned. The tag attached to your backpack lets you know when it is due back to school. It is VERY important to return it on the due date so that we can provide the opportunity for use to as many families as possible!

The backpack includes most of the supplies needed to conduct the experiments. Other items that are needed can be found around your home, i.e. ice and hot water. Please return all items.

We have included a Journal with blank pages for families to share their experiences. Please let us know if you liked the activities, have suggestions for other activities, comments made by your child about the activities or any new discoveries he/she may have made.

Your participation as a family has a major influence on your child's education and is strongly encouraged. I hope that you and your child will have a great time doing these activities. So get ready to have some fun!

SUPPLY LIST ON THE BACK
CLOUDS

SLiC BACKPACK SUPPLY LIST

Please return the below items to the Backpack
Cloud Pronunciations:

<table>
<thead>
<tr>
<th>Cirrus- [sir-uhs]</th>
<th>Cirrocumulus- [sir-oh-kyoo-myuh-uhhs]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cirrostratus- [sir-oh-strat-uhs]</td>
<td>Altostratus- [al-yoh-strat-uhs]</td>
</tr>
<tr>
<td>Cumulus- [kyoo-myuh-uhhs]</td>
<td>Stratus- [strat-uhs]</td>
</tr>
<tr>
<td>Cumulonimbus- [kyoo-myuh-loh-nim-bus]</td>
<td></td>
</tr>
</tbody>
</table>

Why are clouds white?
Clouds are white because they reflect the light of the sun. Light is made up of colors of the rainbow and when you add them all together you get white. The sun appears a yellow color because it sends out more yellow light than any other color. Clouds reflect all the colors the exact same amount so they look white.
Why do clouds turn gray?
Clouds are made up of tiny water droplets or ice crystals, usually a mixture of both. The water and ice scatter all light, making clouds appear white. If the clouds get thick enough or high enough all the light above does not make it through, hence the gray or dark look. Also, if there are lots of other clouds around, their shadow can add to the gray or multicolored gray appearance.

How do clouds move?
Clouds move with the wind. High cirrus clouds are pushed along by the jet stream, sometimes traveling at more than 100 miles-per-hour. When clouds are part of a thunderstorm they usually travel at 30 to 40 mph.

Why do clouds form at different heights in the atmosphere?
The characteristics of clouds are dictated by the elements available, including the amount of water vapor, the temperatures at that height, the wind, and the interplay of other air masses.

Cloud Types, Page 3
**Reading Connections**

**Activity:** Read the book, *Shapes in the Sky: A Book about Clouds*

**Materials**

- *Shapes in the Sky: A Book about Clouds*  
  By Josepha Sherman

**Suggested questions:**

- Where have you seen clouds?  
- What makes a cloud?  
- What are some of the cloud names you learned?  
- What do rain clouds look like?
Cloud Types

Activity: Cloud Watching © 2008 Nature-Watch

Today, you’ll get to become a meteorologist! You will get a chance to identify clouds as well as predict what the weather may.

Materials

- Weather Window

Procedure

1. Go outside and frame a cloud in the center of your Weather Window.
2. Use the cloud pictures to determine what type of cloud is in the sky.
3. Once you know what type of cloud you are looking at then flip the Cloud Window over and read what weather it may bring.

Cloud Types; Page 5
Procedure Continued

4. Draw a cloud you saw in your cloud journal. What type of weather does the cloud bring?

Suggested questions:

- Where do clouds go?
- Are all the clouds the same?
- What picture do you think that cloud looks like?
- How can clouds help us predict the weather?
Activity 2: Cloud in a Jar

In this activity children will be making their own clouds.

Materials
- Jar
- Strainer
- Flashlight
- Hot water (not provided)
- Ice (not provided)
- A dark place (room or under a blanket)

Procedure
1. Fill the strainer with ice cubes and set aside
2. Pour ½- 1 inch of hot water into the bottom of the jar
3. Quickly place the strainer on top of the jar
Procedure Continued
4. Go to a dark place (ex: under a blanket) and move the flashlight around until you can find a good angle that allows you to see into the jar (this could under the jar or on the side) Observe the miniature cloud swirling around.
5. Try and think of another way you could make a cloud. Try it and then share what you did in the Sharing Journal.

Suggested Questions:
- What happened inside the jar?
- What do you think a cloud feels like?
- What did you notice happen when we put the ice on top of the jar?
Appendix C

What’s on the Menu Backpack


2-Way Bug Viewer

By: Elenco

Stack 'N' Nest Cups

By: All About Baby Infant
WELCOME CHILDREN AND PARENTS:

In this Family Science Backpack you will find a book, activities, and ideas for learning about science in a fun and interesting way! The activities are designed for you and your child to explore science together.

The backpack is designed to be taken home for approximately one week and returned. The tag attached to your backpack lets you know when it is due back to school. It is VERY important to return it on the due date so that we can provide the opportunity for use to as many families as possible!

The backpack includes most of the supplies needed to conduct the experiments. Other items that are needed can be found around your home, i.e. bugs. Please return all items.

We have included a Journal with blank pages for families to share their experiences. Please let us know if you liked the activities, have suggestions for other activities, comments made by your child about the activities or any new discoveries he/she may have made.

Your participation as a family has a major influence on your child’s education and is strongly encouraged. I hope that you and your child will have a great time doing these activities. So get ready to have some fun!

SUPPLY LIST ON THE BACK
FOOD CHAINS

SLiC BACKPACK SUPPLY LIST

Please return the below items to the backpack
Family Science Backpacks
Science Literacy
SLiC Connections

What’s on the Menu?
Activity Book
Food Chains:
Every living thing needs energy in order to live. Energy comes from the sun and is at the base of all food chains. Plants use the sun's energy to create nutrients. Animals get energy from the food they eat. A food chain shows how each living thing gets food, and how nutrients and energy are passed from creature to creature. Food chains begin with plant-life, and end with animal-life. Some animals eat plants while some animals eat other animals.

- **Producers**: Plants are producers because they produce their own food, using a process called photosynthesis
- **Consumers**: Animals are called consumers because they cannot make their own food and due to this they eat plants and/or animals
- **Decomposers**: Bacteria and Fungi are called decomposers because they eat decaying matter (dead plants and animals)
Insects:
- The number of insect species is believed to be between six and ten million.
- Insect bodies have three parts, the thorax, abdomen and head.
- Insects have two antennae.
- Insects have three pairs of legs.

Pill Bugs:
- Have 7 pairs of legs
- Pill bugs are crustaceans, not insects. They are closely related to shrimp.
- Pill bugs breathe through gills in their feet and that is why they are always found in moist areas.

Spiders:
- Have 4 pairs of legs
- Spiders are arachnids, not insects.
- Arachnid bodies have two parts, the cephalothorax and the abdomen.

Food Chains; Page 3
Activity: Read the book, *Secrets of the Garden*

Materials
- *Secrets of the Garden*
  By Kathleen Weidner Zoehfeld

Follow up questions:
- What is a food chain?
- What types of plants do you have in your yard?
- What are some animals you have seen in and around your yard?
What’s on the Menu?

Activity: Gobble-up Food Chain

Today, you’ll get a chance to put together a local food chain!

Materials

- 1- set Food Chain Stack N’ Nest cups

Procedure

1. Lay all the cups out and allow the child time to inspect each one. Discuss if you have seen any of these animals in your area.
2. Have the child stack the cups in the correct order of who eats who. This can be done by sliding one cup over the top of another.
Procedure Continued

3. Now that you have successfully made one food chain, try to come up with another food chain and share it in the Sharing Journal.

Suggested Questions

- Why is the sun the starting point of all food chains?
- What are some other types of plants or animals that Red-tailed hawks eat? Scrub Jays? Western Fence lizard? Spiders?
What’s on the Menu?

Activity: Bugs up Close

In this activity you and your child will have the chance to observe and explore the different bugs in your back or front yard.

Materials

- 1- Bug Microscope Viewer

Procedure

1. Explore your yard for bugs.
2. When you find one, place it on the stage and view it up close using the top and side viewer. Discuss what you notice about the bug.
3. Try and determine if this bug eats plants or other bugs
Suggested Questions

- What other animals did you notice in your yard besides bugs?
- Can you think of a food chain that includes some of the bugs you saw?
- What was your favorite bug that you found?
- Where did you find the most bugs? Why do you think they chose to live there?
Appendix D

Acids and Bases Backpack


WELCOME CHILDREN AND PARENTS:

In this Family Science Backpack you will find a book, activities, and ideas for learning about science in a fun and interesting way! The activities are designed for you and your child to explore science together.

The backpack is designed to be taken home for approximately one week and returned. The tag attached to your backpack lets you know when it is due back to school. It is VERY important to return it on the due date so that we can provide the opportunity for use to as many families as possible!

The backpack includes most of the supplies needed to conduct the experiments. Other items that are needed can be found around your home, i.e. various liquids. Please return all items.

We have included a Journal with blank pages for families to share their experiences. Please let us know if you liked the activities, have suggestions for other activities, comments made by your child about the activities or any new discoveries he/she may have made.

Your participation as a family has a major influence on your child’s education and is strongly encouraged. I hope that you and your child will have a great time doing these activities. So get ready to have some fun!

SUPPLY LIST ON THE BACK
SLiC BACKPACK SUPPLY LIST

Please return the below items to the backpack
Family Science Backpacks

Science Literacy SLiC Connections

pH Fun for Everyone Activity Book

Family Science Backpacks

Science Literacy SLiC Connections

pH Fun for Everyone Activity Book
**Acids and Bases:**
Acids and bases are everywhere. Some foods contain acid, like the citric acid in lemons and the lactic acid in dairy. Cleaning products like bleach and ammonia are bases. Chemicals that are acidic or basic are an important part of chemistry.

**Measuring Acids and Bases:**
Scientists use something called a pH scale to measure how acidic or basic a liquid is. pH is a number from 0 to 14. From 0 to 7 are acids, with 0 being the strongest. From 7 to 14 are bases with 14 being the strongest base. If a liquid has a pH of 7, it's neutral. We can tell an acid from a base by using pH indicators. Some pH indicators include: Phenol Red, purple cabbage juice, and litmus paper.
Acids and Bases in Nature:
There are many strong acids and bases in nature. Some of them are dangerous and used as poisons by insects and animals. Some are helpful. Many plants have acids and bases in their leaves, seeds, or even their sap. Citrus fruits like lemons and oranges have citric acid in their juice. This is what makes lemons taste so sour.

Acids and Bases in our Bodies:
Our bodies use acids and bases too. Our stomachs use hydrochloric acid to help digest foods. This strong acid also kills bacteria and helps to keep us from getting sick. Our muscles produce lactic acid when we exercise. Also, our pancreas uses a base called an alkali to help with digestion. These are just a few examples of how the chemistry of bases and acids help our bodies function.
Activity: Read the book, *What Can I Do?*

Materials
- *What Can I Do?*
  By Dr. Kain

Follow up questions:
- What do you think the words Acid and Base mean?
- How can you find out if a material is an acid or a base?
Activity: Liquid Color
You get to become a chemist and do the experiments that Fets did!

Materials
- 1 bottle Phenol Red (Use only with adults)
- Vinegar
- Baking Soda
- Cups
- Water

Procedure
1. Place three cups on a counter or table.
2. Place water in one cup, mix two teaspoons of baking soda and water in the second cup, and vinegar in the third cup.

Acids and Bases, Page 5
Procedure Continued

3. With the assistance of an adult squeeze 10 drops of phenol red into each cup and observe what happens.
4. Repeat steps 2 and 3 with other liquids and powders in your house. Make sure to rinse out the cups each time.

Suggested Questions

- What happens if you mix an acid and base together?
- What color is an acid when using phenol red?
- What color is a base when using phenol red?
**pH Fun For Everyone**

**Activity: Mysterious Strips**

Use litmus paper to determine which foods are acid and which are bases.

**Materials**

- Litmus paper
- Baking Soda
- Vinegar
- Water
- Various liquids and powders

**Procedure**

1. You will need litmus paper. Apply a few drops of your choice of liquid to the paper.
   What happened? Is it an acid or a base?
2. Continue exploring as many liquids as you desire.

**Suggested Question**

- How does litmus paper differ from the phenol red pH indicator?

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**Acids and Bases; Page 7**

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**Activity: Mysterious Strips**

Use litmus paper to determine which foods are acid and which are bases.

**Materials**

- Litmus paper
- Baking Soda
- Vinegar
- Water
- Various liquids and powders

**Procedure**

1. You will need litmus paper. Apply a few drops of your choice of liquid to the paper.
   What happened? Is it an acid or a base?
2. Continue exploring as many liquids as you desire.

**Suggested Question**

- How does litmus paper differ from the phenol red pH indicator?

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**Acids and Bases; Page 7**
Activity: Make Your Own pH Indicator

Materials
- Pot
- Purple Cabbage
- Water

Procedure
1. Boil ½ head purple cabbage in approximately a gallon of water until the cabbage is white and the water is colored purple
2. Strain the boiled cabbage to remove all pieces of cabbage. Save the liquid! Once it has cooled, store the liquid in a closed container in the refrigerator.
3. Use the liquid from the cabbage as a pH indicator in any acid-base experiment.

Acids and Bases, Page 8
APPENDIX E

Sharing Journal Response