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Deepening Understanding of Science Content Through Text Structure Instruction

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DEEPENING UNDERSTANDING OF SCIENCE CONTENT THROUGH TEXT STRUCTURE INSTRUCTION

By

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ABSTRACT

DEEPENING UNDERSTANDING OF SCIENCE CONTENT THROUGH TEXT STRUCTURE INSTRUCTION

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The purpose of this study was to examine the effectiveness of an instructional program designed to explicitly teach text structure awareness to fourth grade students to assist in their understanding of science content in a unit of study on weather. The changes that occurred in teacher thinking and practice were also examined throughout the process of developing and implementing the instructional program. A quantitative analysis was performed to reveal any differences in mean posttest scores between a control group and a treatment group. Results indicated that the treatment group students' science content knowledge was increased significantly more than the students in the control group. A qualitative analysis was also performed to reveal the changes that occurred while this program was implemented into science instruction. Results indicated that by using research and results to guide her instruction, the researcher became more refined as a teacher. Recommendations for further research are discussed.

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CHAPTER 1

INTRODUCTION

The period of 1910-2009 represents a century of efforts to change science education (Hurd, 1998). However, regardless of continued attention to science education throughout the years, a vast number of young Americans remain ill prepared to work in, contribute to, or profit from our technological society as a result of an inadequate grounding in mathematics, science, and technology (National Science Foundation [NSF], 1983). Consequently, researchers have explored possible issues that have contributed to our nation's failure to develop scientifically literate individuals. A number of these researchers have suggested that students' inability to negotiate the language of science limits their ability to learn science (Norris & Phillips, 2003; Obsborne & Wittrock, 1983). These researchers conclude that because the understanding of science concepts and the ability to communicate about science require the use of language, understanding the relationship between science and literacy may enable educators to improve the overall quality of science education. As Wellington and Osborne (2001) argue, "Paying more attention to language is one of the most important acts that can be done to improve the quality of science education" (p. 1).

The most current science education reform states that teaching and learning science should be a goal aimed at *all* citizens (Hurd, 1998), with the central objective of developing a scientifically literate society (American Association for the Advancement of Science, [AAAS] 1995; Southerland, Smith, Sowell, & Kittleson, 2007; Yore, Bisanz, & Hand, 2003). In fact, "scientific literacy" has been referred to as one of the greatest desired outcomes of student learning in science (DeBoer, 1991, 2000; Norman, 1998;

Shamos, 1996) and has been used "to describe a familiarity with science on the part of the general public" (DeBoer, 2000, p. 582). As a result, science educators have been charged with the responsibility to provide to *all* students "a broad understanding of science and of the rapidly developing scientific enterprise whether one was to become a scientist or not" (p. 586). Based on this definition, scientific literacy is more than just knowing facts and vocabulary; it is understanding the processes and the nature of science and being able to make meaning of the body of scientific knowledge (Lee, 1997).

Text Structure Instruction in Science

In school, students are continually exposed to a variety of social and academic languages within each subject. Understanding these languages potentially increases students' content knowledge and improves discipline-specific literacy (Moss, 2005). Students, therefore, must learn to comprehend and effectively use these languages in order to achieve success in specific content areas such as science (Williams, Hall, & Lauer, 2004).

Gaining a facility with the language of science is particularly important as students enter the intermediate grades in school because by the time students reach fourth grade, a large part of the text that they encounter in school is informational (texts that convey and communicate factual information) (Chall & Jacobs, 2003; Venezky, 2000). As a result, students who are not prepared to successfully negotiate this type of text may find it extremely difficult to learn, understand, and apply new content knowledge (Hall, Markham, & Culatta, 2005a). Additionally, it has been suggested that if today's students are to truly meet the literacy demands of their futures, they need authentic experiences with informational texts from the beginning of their school careers (Alvermann, Swafford,

& Montero, 2004; Lemke, 2004; Moss, 2005; Ogle & Blanchowicz, 2002; Williams, Hall, Lauer, Stafford, & DeSisto, 2005).

In order to better understand how to prepare students with the skills and strategies needed to negotiate informational text, researchers have begun to examine the influence that text structure awareness (understanding the way an author arranges information in a text) has on student comprehension (Alvermann et al., 2004; Dickson, 1999; Williams et al., 2005). This work has explored promoting text structure awareness, including explicitly teaching students to (a) be aware of the internal and external structure of a text (Brooks, Dansereau, Spurlin, & Holley, 1983), (b) use graphic organizers while reading informational text (Bakken & Whedon, 2002), and (c) focus on one or more of the conventional text structures (Armbruster, Anderson, & Ostertag, 1989; Williams, Nubla-Kung, Pollini, Stafford, Garcia, & Snyder, 2007). The most common types of conventional informational text structures have been identified as: description, temporal sequence of events, explanation of concepts, definition and example, compare/contrast, cause/effect, and problem-solution-effect (Armbruster, Anderson, & Ostertag, 1987; Bakken & Whedon, 2002; Brooks et al., 1983; Ciardiello, 2002; Dreher & Singer, 1989; Montelongo, Berber-Jimenez, Hernandez, & Hosking, 2006; Neufeld, 2005; Williams, 2005).

Statement of the Problem

An instructional focus on text structure awareness may be relevant in helping students learn to cope with informational text; however, much of the existing research (excluding the few studies described in the review of literature) has been mainly with intermediate and secondary students, and adults, rather than early elementary age

students (Pearson & Dole, 1987; Williams et al., 2004). Further research, particularly that which focuses on each individual text structure, and research with young (Grades 2-4) elementary age students, seems warranted because so many young students, when dealing with informational text, appear to be insensitive to informational text structure and, therefore, have difficulty with comprehending this type of text (Pearson & Duke, 2002; Taylor, 1982; Williams et al., 2007).

Research Questions

This study sought to explore how an increased awareness and understanding of the cause/effect text structure affect students' comprehension of science content. To that end, two of the questions guiding this study were

1. What effect does explicit instruction designed to enhance students' awareness and understanding of expository text structure (e.g., cause/effect) have on students' learning in science?
2. What effect does this instruction have on students' ability to identify and use this text structure?

A third question investigated my experience, as the classroom teacher and researcher, while implementing this instructional program. The hope was that this exploration would provide a better understanding of a teacher's thinking as new instructional practices were adopted:

3. What changes in teacher belief and instructional practice occur as a result of developing and implementing an integrated science and literacy unit that explicitly teaches text structure awareness as a means of enhancing students' science content knowledge?

CHAPTER 2

LITERATURE REVIEW

Recent calls from scientists, educators, public figures, and other policy makers are for the school curriculum to reflect the real-world needs of students within a society increasingly impacted by science and technology (Lang, Drake, & Olson, 2006). Amidst responses to these petitions to reform science education, a number of researchers have begun to examine the links between science and literacy. Much of this research suggests that because language and science are inextricably interrelated, understanding the connections between them may enable educators to improve the quality of science teaching and learning and reflect the needs of students (Norris & Phillips, 2003).

This study is grounded in the current literature on these important links between science and literacy and will draw upon two main bodies of research: that which describes the history of science education reform and the literature that explicates what is known about linking science and literacy. More specifically, the contents of this literature review will focus primarily on (a) the current science education reform movement, which emphasizes the development of scientifically literate individuals; and (b) the key factors and issues related to improving the quality of science education through integrating science and literacy.

The History of Science Education Reform

The period of 1910-2009 represents a century of ever-changing landscape of science education reform (Hurd, 1998). The United States alone has seen three major science reform movements in an effort to change the way science is taught in schools so that students can acquire essential scientific knowledge (Hurd, 1998; Shamos, 1996).

Speaking of this period of time, DeBoer (1991) writes, “Science has come to be viewed as a fundamental aspect of our culture, and is, therefore, an essential part of the curriculum” (p. 216). The following paragraph will briefly introduce each of the three major science education reform movements that have occurred in the United States. Each will then be reviewed below in greater detail.

Science initially became part of the general education of most high school students in the United States during the 19th century due to urgings from scientists. The main goal of this first reform effort was to develop scientific habits of mind in students (DeBoer, 2000; Shamos, 1996). Later, after World War II, largely because of personnel shortages in scientific, technical, and industrial fields, the importance of science in the school curriculum once again became a major focus (Hurd, 1998). At this time, a massive curriculum reform effort began, which included scientists and university faculty rewriting curriculum and textbooks so that students with the most promising futures in science would receive the instruction needed (DeBoer, 2000). The focus was on science to develop scientists. This curriculum, however, was viewed by many teachers as too difficult for most students and was, therefore, not fully implemented in the schools (Yee & Kirst, 1994). This second reform movement soon came to an end when it was realized that academic performance in science as a nation began to fail (Shamos, 1996). As a result of this awareness, the National Science Foundation Advisory Committee for Science Education proposed that science should not only be for the elite few, but for *all* citizens (Hurd, 1998). Thus, the most current reform movement in science education has come to be known as the era of “scientific literacy” (AAAS, 1995; Shamos, 1996).

The first reform, beginning in about 1910 and lasting until the post-World War II period, was brought on by urgings from scientists themselves. Their main desire was to develop ways of thinking in students that mirrored the way scientists thought about the natural world (DeBoer, 1991). They emphasized the importance of providing this broad understanding and the way that it affected people's personal and social lives (DeBoer, 2000; Shamos, 1996). Although these efforts did not result in completely changing the scientific habits of mind in students, they did result in science becoming a part of the general education of most high school students (Shamos, 1996).

Following World War II (in the late 1940s and early 1950s) and extending to the early 1980s, the second reform movement in science education was brought on as the United States moved into an era that was increasingly dominated by science and technology. With dramatic changes in society resulting from the devastations of World War II, followed by the successful launch of *Sputnik I* in 1957 by the Soviet Union, the impact on the social, economic, and political foundations of the nation triggered what came to be known as the Curriculum Reform Movement or Alphabet Soup Era (Bybee, 1997; DeBoer, 2000; Hurd, 1998; Yee & Kirst, 1994) because many curricula were developed and were known by their acronyms (*e.g.*, SAPA and SCIS).

Up until the 1950s the school curriculum had traditionally been controlled by individual school systems in response to the perceived needs of the local communities (Yee & Kirst, 1994). However, after the devastations of World War II and the perceived drain of science talent, national government agencies and policy makers argued that science education in the United States was in great need of modernization; curricula and textbooks needed to better reflect science as seen through the eyes of professional

scientists (DeBoer, 1991; Shamos, 1996). These ideas triggered a major curriculum reform effort, which included reaching a consensus on what promising students needed to know in order to develop into the scientists of the future (DeBoer, 2000). The new curricula were created primarily by scientists and university faculty in order to provide science teachers with the most current content and pedagogy (Bybee, 1997). These curricula received little or no input from K-12 classroom teachers. Moreover, they were designed to be "teacher proof," meaning that teachers were to act as the transmitters of the scripted curriculum (Yee & Kirst, 1994) and, therefore, could not "mess them up" (Yager, 1992, p. 905). However, although pleasing to the scientific community, this effort seemed to run out of steam in the late 1970s due to limited teacher implementation. As a result, this reform effort had only marginal effect on teacher practice or student achievement (Shamos, 1996).

By the mid 1980s, a more critical look into the trends of public education revealed that the average science proficiency among students was below that of students in the 1970s (AAAS, 1995) and had fallen below that of students in many other industrialized nations. As a result, scientists, educators, public figures, and other policy makers issued a third call for changes in the way science is taught in schools, including a major change in focus relative to which students should be targeted during science instruction. The Curriculum Reform Movement had emphasized curricula focusing on science for students with abilities that suited them for the most promising careers as future scientists—"science for scientists" (DeBoer, 1991; Duschl, 1990). In contrast, this latest and current reform movement in science education focuses on *all* children, not just a select few, with the overarching goal to develop a scientifically literate population

(AAAS, 1995; Southerland, Smith, Sowell, & Kittleson, 2007; Yore, Bisanz, & Hand, 2003). This reform effort has come to be known as the era of "scientific literacy" (AAAS, 1995; Shamos, 1996).

The Nature of Scientific Literacy

Reform initiatives continue to claim the term "scientific literacy" as one of the greatest desired outcomes of student learning. However, from the 1950s up until today, this term has defied precise definition (DeBoer, 1991, 2000; Norman, 1998; Shamos, 1996), an issue that complicates reform efforts. The term was first introduced in the late 1950s by Conant in the book *General Education in Science* (1952) as World War II came to a close (Shamos, 1996). At that time, scientific literacy was associated with science policy and meant "an ability to cope with the societal implications of science, from understanding what science does to exercising control over it" (p. 46). Gradually, however, the educational community expanded the definition of the term "to describe a familiarity with science on the part of the general public" (DeBoer, 2000, p. 582). This meant that the responsibility of science educators was to provide to all students "a broad understanding of science and of the rapidly developing scientific enterprise whether one was to become a scientist or not" (p. 586). Researchers (DeBoer, 2000; Lang et al., 2006) agree, however, that without a consensus concerning the meaning of this broadly defined term, "science reform becomes a vague notion at best" (DeBoer, 2000, p. 582).

Despite the attention that has been given to science education throughout the years, schools in the United States continue to fail to effectively educate students for a world that has become so heavily dependent upon science and technology (Aldridge, 1992; Berry, Champagne, Penick, Raizen, Weiss, & Welch, 1988; Eisenhart, Finkel, &

Marion, 1996; Lang et al., 2006; Shamos, 1996; Yee & Kirst, 1994). There are an alarming number of young Americans who are not prepared to work in, contribute to, profit from, and enjoy our technological society as a result of an insufficient grounding in mathematics, science, and technology (NSF, 1983). Indeed, it has been suggested that students even "lack sufficient knowledge to acquire the training, skills, and understanding that are needed today and will be even more critically needed in the 21st century" (NSF, 1983, p. 19). Concerning this trend, Berry et al. (1988) stated,

> Because elementary science instruction tends to be weak, many students—especially those in less affluent schools—are inadequately prepared for middle school science. The failure they experience in middle school may convince these young people that they are incapable of learning science, thus contributing to the low enrollments observed in high school science courses. Unless conditions in the nation's schools change radically, it is unlikely that today's 9 and 13 year-olds will perform much better as the 17 year-olds of tomorrow. (pp. 6-7)

A number of researchers have begun to explore possible factors that have contributed to our nation's failure in science education and have found considerable links between science and literacy (Norris & Phillips, 2003; Osborne & Wittrock, 1983). These researchers conclude that because understanding science concepts and communicating about science requires the use of language, understanding the connections between science and literacy may enable educators to improve the overall quality of science education. For example, Yore, Bisanz, and Hand (2003) argue that the quantity and quality of oral interactions in science classrooms are typically low and unfocused and that this may be a major contributor to students' inability to learn science effectively.

Wellington and Osborne (2001) agree that the connections between language and science learning are critical, claiming that "for many pupils the greatest obstacle in learning science—and also the most important achievement—is to learn its language" (p. 3). Yore and Treagust (2006) have also argued that the educational systems of today do not place sufficient emphasis in the science curriculum on students' cognitive tools and communication abilities, which would aid students in maintaining and renewing their science knowledge after leaving the formal education system.

The Literacy Component of Scientific Literacy

In the English language, the term "literacy" is understood in two distinct ways. In one sense, Norris and Phillips (2003) propose, literacy refers to the ability to read and write. In the other sense, "literacy means knowledgeability, learning, and education" (p. 224). They go on to argue that "The two senses are related. A person can be knowledgeable without being able to read and write: individuals can learn much by trial and error, word of mouth, and apprenticeship" (p. 224). In applying the definition of the term "literacy" to a certain disciplined body of knowledge such as science, however, the link between knowledgeability and the ability to read and write becomes tightly connected (Norris & Phillips, 2003). Thus, scientific literacy entails communicating and knowing science in both a "fundamental" and "derived" sense. The fundamental sense refers to being able to communicate (read, write, speak, and listen) in science, where comprehending, interpreting, analyzing, and the critiquing of differing forms of text are of great importance. In contrast, the derived sense is defined as being knowledgeable, learned, and educated in science. This aspect of the definition of scientific literacy involves more than just knowing facts and vocabulary; it also means that one understands

the processes of science, the nature of science, and is able to make meaning of the body of scientific knowledge (Lee, 1997).

Scientific literacy, then, is not simply being able to read and write about science, nor is it only about memorizing the vocabulary of science. Rather, for students to achieve scientific literacy, "they must not only learn and remember what science texts say by decoding the words and locating information in them, but also develop the ability to read those texts from a theoretical perspective" (Norris & Phillips, 2003, p. 235). In addition, students must be able to gather meaning based on this theoretical perspective from verbal concepts, mathematical relationships, and visual representations (Lemke, 2004; Norris & Phillips, 2003; Yore, 2004). In essence, scientifically literate individuals not only possess knowledge about scientific principles and concepts, but they have the ability to use their knowledge in varied contexts and for worthwhile purposes (Eisenhart et al., 1996).

One who is unable to communicate within the discipline of science (the fundamental sense of scientific literacy) may find that his or her depth of scientific knowledge, learning, and education (the derived sense of scientific literacy) is limited (Norris & Phillips, 2003). Indeed, the idea that reading is just an ability to decode words properly is an all-too-simplistic view in that just decoding the words does not entirely yield complete comprehension of what is read (Norris & Phillips, 2003). Rather, understanding text also requires an active construction of new meanings and an ability to use comprehension strategies to aid in the reading process for a more complete understanding (Block & Pressley, 2002). Therefore, Norris and Phillips (2003) propose that "the fundamental sense of literacy is central to scientific literacy" (p. 224).

Linking Science and Literacy in School

Reading and writing in school are "both embedded in and integrated with learning, using, and talking about specific content" (Gee, 2004, p. 13). In essence, as students read and write texts in different disciplines, they are exposed to the social and academic languages used within each subject, which potentially increases their content knowledge and heightens their awareness of how discipline-specific texts are created (Moss, 2005). Thus, achieving success in specific content areas relates to the learner's ability and willingness to cope with these social and academic languages as well as his or her ability to comprehend the texts used within each subject (Williams et al., 2004).

It is through language that the nature of science and scientific inquiry is communicated (Yore, 2004, p. 72). Thus, comprehending the language of science is critical and requires an understanding of how science text (both written and spoken) is organized. In looking at skills or strategies that students might use to allow them to negotiate this discipline-specific type of text, researchers have begun to examine the influence of text structure awareness (Alvermann et al., 2004; Dickson, 1999). This research suggests that instruction that focuses on helping students become aware of the way text is organized or structured is effective in improving their ability to comprehend informational text.

The Challenges of Text Structure

Stories, textbooks, and informational books all have something in common: the authors of these texts do their best to organize their writing in ways that readers can easily understand. These authors organize their writing by choosing a text structure (the way an author arranges information in a text) that best matches the content they wish to

convey to readers (Alvermann et al., 2004; Dreher & Singer, 1989; Hall, Sabey, & McClellan, 2005b). Sometimes, for example, if an author wishes to tell a story, he or she may choose to write using a narrative or story structure (*e.g.*, setting, characters, problem, solution, and outcome). At other times, however, an expository (informational) structure (*e.g.*, cause/effect, problem/solution, compare/contrast) is chosen because the author may feel that it is the most effective way to communicate the content or ideas (Alvermann et al., 2004).

Narrative text (*e.g.*, stories, fables, fairy tales) is organized according to a sequential pattern of events that consistently follows the conventions of story grammar (setting, characters, problem, solution, and outcome) (Baumann & Bergeron, 1993; Hall et al., 2005b; Rhoder, 2002; Taylor, 1982). Most children start school with an awareness of narrative structure because a large part of the reading that parents do with their preschool children is from storybooks (Bakken & Whedon, 2002; Williams et al., 2004). Because the structure of narrative text is familiar to children, due also in part because they have generally learned to read using this type of text, stories and other literature are generally easy to comprehend. Children "know what to expect, and they can then focus their attention on remembering what they have read" (Bakken & Whedon, 2002, p. 230).

Unlike narrative text, informational text (texts that convey and communicate factual information) is regarded as a more difficult text to understand (Hall et al., 2005b). Ideas presented in informational text are not the simple sequence of events so often found in a story; rather, the ideas depict abstract logical relations (Stein & Trabasso, 1981; Williams et al., 2004). Because of this, as students read informational text they may feel a

sense of frustration with unfamiliar vocabulary, concepts, and an often inconsistent and unpredictable organizational structure (Bakken & Whedon, 2002).

This struggle with informational text is particularly problematic for many children because by the time they reach fourth grade, a majority of the text students encounter in school is informational in nature (Chall & Jacobs, 2003; Venezky, 2000). Students at this time begin to experience what Chall and Jacobs (2003) refer to as the "fourth-grade slump" (p. 15). This term refers to the fact that many children in the intermediate grades begin to (a) have greater difficulty with vocabulary and the associated concepts presented in informational texts (word meanings) and (b) find that they are not prepared to meet the challenges of the abstract, technical, and literary terms so often found in the content area reading materials used in these grades. As a result, some students may find it difficult to learn, understand, and apply new content knowledge (Englert & Thomas, 1987; Williams et al., 2007).

It is because of the difficulties students face while encountering informational text that a number of scholars (Alvermann et al., 2004; Lemke, 2004; Moss, 2005; Ogle & Blanchowicz, 2002; Williams et al., 2005) suggest that if today's students are to truly meet the literacy demands of their futures, they need individual and authentic experiences with informational texts from the beginning of their school careers. These scholars agree that teaching students strategies to derive more meaning from text, such as text structure awareness and how to apply these specific strategic cognitive processes, will improve students' overall comprehension of informational text.

Structure of Informational Text

Alvermann and her colleagues (2004) explain that text structure provides the framework within which ideas are organized, where both the external organizational features and the internal organizational structures guide readers toward a more efficient understanding of a text's content. External organizational features (sometimes referred to as access features), such as a table of contents, index, glossary, headings, and subheadings, are cues built into a text that provide readers with easier access to important information (Armbruster et al., 1987; Brooks et al., 1983). Internal organizational structure refers to how ideas are ordered or arranged and can be linked systematically within paragraphs, sections, and chapters (Alvermann et al., 2004). Without these organizational features, "reading would be a more laborious process; there would be no signposts to help navigate your way through a text" (Alvermann et al., 2004, p. 80). Additionally, Alvermann and her colleagues (2004) add that this lack of cohesion in a text may also contribute to comprehension difficulties.

Authors of informational text compose using a variety of internal organizational structures. As previously mentioned, the types of internal informational text structures that have been defined are: description, temporal sequence of events, explanation of concepts, definition and example, compare/contrast, cause/effect, and problem-solution-effect (Armbruster et al., 1987; Bakken & Whedon, 2002; Brooks et al., 1983; Ciardiello, 2002; Dreher & Singer, 1989; Montelongo et al., 2006; Neufeld, 2005; Williams, 2005). For example, authors writing with the intent to explain how actions of events cause something to happen may compose using a cause/effect structure to organize the main ideas and details (Alvermann et al., 2004). Through the use of key words in the text (*e.g.*,

reasons why, as a result, because, if…then, since, causes, as a result, this led to), an author provides a reader with a structured paragraph or group of paragraphs that will allow him/her to analyze causes and effects (Alvermann et al., 2004; Williams et al., 2007). Thus, a cause/effect structure may be used to describe elements of the weather: "A tornado struck downtown Salt Lake City, and, as a result, many people were injured." In this instance, the key word/phrase "as a result" is used to signal to the reader that the tornado caused injury to people.

A reader's sensitivity to text structure is a very important component of text comprehension and memory (Alvermann et al., 2004). Readers seldom have the ability to remember every detail of a text. As a result, they must form a macrostructure, or gist, of the important ideas expressed in the text, which then aids them in remembering the concepts (Duke & Pearson, 2002; Taylor, 1982; Williams et al., 2007). Several researchers (Brown, 2002; Montelongo et al., 2006) have examined the effect of readers' sensitivity to the author's text structure and their ability to comprehend and recall important information associated with informational text. These researchers conclude that understanding how the ideas are organized or structured within a text can help students keep track of information and better understand important relationships between ideas.

Teaching Text Structure Awareness

Because the structure or organization of informational text differs substantially from that of narrative text, students need explicit instruction in specific strategies to aid them in identifying different types of text structure (Bakken & Whedon, 2002; Montelongo et al., 2006) as well as how to apply appropriate structure-specific strategies when they are reading a text they do not comprehend (Williams et al., 2004). One way

teachers can support students' comprehension of and strengthen their ability to read and understand informational texts is to explicitly teach children to attend to the way ideas in the text are structured (Williams, 2005). Williams, Hall, and Lauer (2005) state that it is of extreme importance that students are provided with instruction that will prepare them to deal with whatever type of text they encounter. Indeed, providing more experiences with informational texts, and explicitly teaching students to be aware of text structure may help alleviate the substantial difficulty many students continue to have comprehending informational text throughout their schooling (Bakken & Whedon, 2002; Berkowitz, 1986; Lemke, 2004). In addition, teaching students to develop a specific awareness of and ability to use text structure to support their understanding while reading a text may provide them with the necessary tools to transfer what they have learned across a wide variety of texts and disciplines (Perkins & Salomon, 1988; Rhoder, 2002).

Research has suggested a number of approaches teachers can implement in order to foster an awareness of text structure (Armbruster et al., 1987; Armbruster et al., 1989; Ciardiello, 2002; Spiegel & Barufaldi, 1994; Williams et al., 2007). One approach is to teach readers to generate a concrete representation of the organization of the ideas from the text that they read (Armbruster et al., 1989). For example, Armbruster et al. (1987) have demonstrated the positive effects of constructing graphic organizers, such as networking and mapping, to enhance students' sensitivity to the structure of informational text, where students draw a diagram that represents ideas and relationships between ideas in a text they are reading. Data suggested that using these strategies enhanced readers' recall of informational text.

Another approach to teaching text structure awareness in order to enhance comprehension is to provide the reader with explicit instruction about one or more of the more conventional text structures (Ciardiello, 2002; Williams et al., 2007). The term explicit refers to lesson delivery, where the instruction is not just a mention of a skill or strategy, but a deliberate demonstration that offers learners the precise awareness of the skills which they need to master if they are to become effective readers (Williams et al., 2007). The results of a study that was conducted with middle school students suggested that students who received explicit instruction about a conventional informational text structure (problem/solution) recalled more information on an essay test about the text read than students who received more traditional instruction that included general comprehension questions and summarization (Taylor, 1982). In another study, Hall et al. (2005b) investigated the effectiveness of an instructional program designed to explicitly teach second graders expository (informational) text comprehension strategies during small-group (guided reading) instruction. Students in the treatment group received this text structure instruction and were specifically taught about clue (key) words to help them identify and analyze causes and effects in well-structured paragraphs. The students involved in this instructional program were compared to students taught using a content only program that did not receive text structure instruction, and to a group of students (control group) who received no-instruction. The results of this study suggested that the text structure program improved the comprehension of cause/effect texts, but did not have a strong transfer effect, meaning that the students did not have the ability to transfer their knowledge and use of the text structure to another context. Concerning this transfer issue, Williams et al. (2004) state,

> It is not uncommon to find that after reading comprehension instruction, students do better on tests that involve the same material on which they were instructed. However, it is less common to find positive effects of the instruction when the tests involve new material not seen in instruction. (p. 140)

The conclusion was that providing a greater amount of instruction while teaching about text structure might lead to more transfer.

An instructional focus on text structure awareness may be beneficial in improving readers' comprehension and memory of informational text material; however, most of the existing research has been applied mainly to secondary students and adults, rather than elementary age students (Pearson & Dole, 1987; Williams et al., 2004) (excluding the few studies described in this review). Further research, particularly with young (Grades 2-4) elementary age students, seems warranted because so many young students, when encountering informational text, appear to be insensitive to informational text structure. This may contribute to their difficulty with comprehension of the text (Pearson & Dole, 2002; Taylor, 1982; Williams et al., 2007). Additionally, in her research with teaching an instructional program which taught informational text structure (compare/contrast), Williams (2005) concluded that it was not clear how long-lasting the effects of her instruction were, but that highly structured explicit reading comprehension instruction is appropriate for elementary school children, especially those at risk for academic failure.

Other research has demonstrated that some text structures, specifically the cause/effect structure, are more difficult for students to comprehend than others (Taylor, 1982). Based on this notion that understanding of different text structures varies, Armbruster and her colleagues (1989) have called for further research on investigating

the distinctive contribution of each type of text structure, and how each affects the comprehension of young children. With this appeal in mind, this study sought to explore how an increased awareness and understanding of the cause/effect text structure through an instructional program designed to explicitly teach students strategies for comprehending informational text affected students' comprehension of science content. Two research questions guided this portion of the study:

1. What effect does explicit instruction designed to enhance students' awareness and understanding of expository text structure (e.g., cause/effect) have on student learning in science?
2. What effect does this instruction have on students' ability to identify and use this text structure?

In addition to exploring how the instructional program influenced student learning, I also recognized the importance of understanding how the implementation of such instructional changes impacts teacher thinking. Thus, I also investigated how developing and implementing the integrated unit impacted my beliefs and practice as a classroom teacher. In order to address this aspect of the study, I chose to explore a third research question:

3. What changes in teacher belief and instructional practice occur as a result of developing and implementing an integrated science and literacy unit that explicitly teaches text structure awareness as a means of enhancing students' science content knowledge?

Thus, the final section of Chapter 2 briefly discusses the teacher change literature as it relates to enacting change in the classroom.

Teacher Beliefs, Practice, and Change

Attitudes that teachers have about teaching and learning have generally been referred to as teachers' beliefs (Pajares, 1992; Richardson, 1996). Teacher beliefs are also oftentimes compared to or equated with knowledge and personal convictions (Oliver & Koballa, 1992). These beliefs are usually developed through an accumulation of experiences through months and years in the classroom (Lortie, 1975) as students and then as teachers. They consist of what a teacher believes, knows, or understands about teaching, learning, students, and a myriad of classroom situations (Bullough & Baughman, 1997; Lumpe, Haney, & Czerniak, 2000; Richardson, 1996).

Studies have shown that there is a strong relationship between teachers' beliefs and their instructional practice (Brickhouse, 1990; Cronin-Jones, 1991; Laplante, 1997; Parjares, 1992; Smith, 2002; Tsai, 2002). The results of these studies illustrate how teachers' beliefs about science teaching and learning tend to determine, in large part, their teaching methods and strategies. Consequently, research on teachers' beliefs has become one of the major concerns for studies of teaching and teacher education (Tsai, 2002). Indeed, a number of researchers (Hargreaves, 1994; Laplante, 1997; Pajares, 1992; Richardson, 1996; Richardson, Anders, Tidwell, & Lloyd, 1991; Smith, 2002) conclude that the study of teachers' attitudes and beliefs is not only essential to efforts to improve classroom instructional practice, but critical for understanding teachers' thought processes and teacher change. They have also concluded that studying teachers' beliefs related to change in the classroom can also be helpful in developing and implementing new programs and effective in-service education.

While it is generally understood that they are profoundly resilient (Pajares, 1992), individuals' beliefs can change in response to new experiences. Thus, as teachers engage in the process of teaching, they may develop new ways of believing and thinking (Lave & Wenger, 1991). Bullough and Baughman (1997) state, "As humans, we do not only seek to assimilate new phenomena to our current belief systems; we also engage in accommodation and create new beliefs, new ways of being in the world in response to new experience" (p. 75). Smith (2002) concurs:

> Researchers have studied teachers throughout their educational careers in an effort to describe the factors that prompt and influence the development and evolution of their beliefs about teaching and learning. They have discovered that teachers' educational beliefs are modified through teaching experience and in relationship to others within their community of practice. (p. 55)

Thus, teachers' beliefs are thought to influence and drive their actions; however, experiences and reflection-on-action may also lead to changes in and/or additions to teachers' beliefs (Bullough & Baughman, 1997; Richardson, 1996).

As has been previously discussed in this literature review, the resounding message of the current science reform movement is: "Science standards [in our schools must be] for all students. The phrase embodies both excellence and equity. The standards apply to all students, regardless of age, sex, cultural or ethnic background, disabilities, aspirations, or interest and motivation in science" (National Research Council [NRC], 1996, p. 2). Simply put, if the goal is that every student should have the opportunity to attain scientific literacy, then it becomes necessary to understand how to teach all students and

how to help teachers develop the professional skills and beliefs required to facilitate this vision of science literacy for all (Southerland et al., 2007).

Nevertheless, because teachers invest emotionally and intellectually in their beliefs and teaching practice, change can be extremely difficult (Bullough & Baughman, 1997; Smith, 2002; Southerland et al., 2007). Because of this difficulty, not every teacher will seek self-development (Bullough & Baughman, 1997). Those who do, may be more willing to consider new ways of doing things. As Smith (2002) states, "As teachers practice and participate in furthering their own professional education, they more fully develop their reflective judgment" (p. 59). Such teachers "want to develop—they *believe* that the outcome, the risk to self, will be worthwhile" (Bullough & Baughman, 1997, p. 77).

If teachers rely upon their beliefs as "a guide to personal thought and action" (Harvey, 1986, p. 660), meaningful and genuine change in both beliefs and practice in the classroom can come about when teachers come to think differently and experiment with new ideas (Cronin-Jones, 1991; Richardson et al., 1991). Understandably, "the people who develop . . . are those who love to learn, who seek new challenges, who enjoy intellectually stimulating environments, who are reflective, who make plans and set goals, who take risks" (Bullough & Baughman, 1997, p. 174). Exemplary teachers are those who constantly seek change and improvement (Yager, 1988).

Based on the literature about teacher change that has been described in this section of the review, it is clear that change is central to improving education (Smith, 2002) and that purposeful and real change can come about as teachers experiment, reflect, and think differently about their teaching. Since students have been labeled the "most

influential contextual component, the one that matters most" (Bullough & Baughman, 1997, p. 69), teachers should act according to the highest standards of their profession to enact appropriate change in the classroom for the benefit of students. This study was based on these premises.

CHAPTER 3

METHODS AND PROCEDURES

The purpose of this study was twofold. First, this study examined the effectiveness of an instructional program designed to explicitly teach students a strategy intended to enhance their awareness and understanding of informational text, thereby supporting their understanding of science concepts. More specifically, this aspect of the study focused on the impact of teaching students one text structure typically found in science texts (cause/effect) using a three-step instructional process, as described by Rhoder (2002). The goal was to explore students' ability to learn and transfer the literacy strategy to a situation where they were learning new science content. Second, this study investigated the changes that occurred in teacher thinking and practice throughout the process of developing and implementing this integrated instructional program.

Research Design

With these purposes in mind, a mixed research methodology was used to conduct this investigation. Mixed method research addresses a research topic or related topics using both quantitative and qualitative techniques. "This means that in mixed method research a qualitative research study and a quantitative research study essentially are conducted as part of a larger, overall study" (Johnson & Christensen, 2004, p. 418). Johnson and Christensen (2004) state that, in essence, both types of data support one another, and that when used together, quantitative and qualitative research strategies produce more complete knowledge necessary to inform theory and practice. A quantitative methodology is particularly useful when numerical data are collected, which are usually analyzed through the use of computerized statistical analysis programs (such

as SPSS) that allow the researcher to scrutinize, chart, and better understand data (Salkind, 2004). A numerical approach to a study allows the researcher to focus on specific factors in the research to determine the statistical significance of the results (Johnson & Christensen, 2004). Qualitative research is helpful for evaluating the data and exploring new phenomena or for documenting participants' internal perspectives or personal views. In relation to this study, quantitative methods were used specifically in answering questions 1 and 2 for evaluating the numerical data obtained from the pre and post testing of the instructional program. Because a qualitative approach to a study allows the researcher to develop hypotheses, theoretical explanations, and interpretations, a qualitative approach to questions 1 and 2 was also necessary (Johnson & Christensen, 2004). This allowed space for insights and understanding that might have been missed if only a single quantitative method was used. In addition, because I sought to interpret the changes that occurred in my thinking and practice as a result of implementing this program (question 3), a qualitative approach to this portion of my study was also necessary. In short, a mixed method approach to this study was chosen because using both quantitative and qualitative data sources enabled me to more completely explore the research questions—questions that required a convergence of types of information.

The questions guiding this study were:

1. What effect does explicit instruction designed to enhance students' awareness and understanding of expository text structure (e.g., cause/effect) have on student learning in science?
2. What effect does this instruction have on students' ability to identify and use this text structure?

3. What changes in teacher belief and instructional practice occur as a result of developing and implementing an integrated science and literacy unit that explicitly teaches text structure awareness as a means of enhancing students' science content knowledge?

To investigate the first two research questions, regarding the effectiveness of the instructional program, a nonequivalent comparison design using quantitative research methods was used. This quasi-experimental design consisted of a treatment group and a control group, both of which were administered pretest and posttest measures. Unlike other designs, this form of research lacks a key feature of being able to randomly assign subjects to equivalent groups. Instead, groups are selected that are as similar as possible so that the researcher can fairly compare the treated one with the comparison one. However, it is often likely that the groups are not completely equivalent and, as a result, they are termed "nonequivalent" (Trochim, 2006). For example, the two groups selected for this study were chosen because they were both fourth grade classes in the same elementary school. Even though it is customary at this school for the teachers to separate the students into classes for the upcoming year to ensure a balance of student abilities, learning levels, and other factors that may have an impact on the climate of the classroom, there may still have been student differences at the outset of the study. Thus, the groups were initially viewed as nonequivalent.

Data Collection

Quantitative. To determine if one of the groups of students might have higher reading comprehension ability that might advantage them on a science assessment, 2 weeks prior to the start of the unit I administered the Gates-MacGinitie test to both

groups. As a nationally-known instrument, the Gates-MacGinitie test is used widely and provides information concerning the general reading ability of individuals (MacGinitie & MacGinitie, 1985; MacGinitie, MacGinitie, Maria, & Dreher, n.d.). An extensive norming study was originally completed in 1999 (MacGinitie, MacGinitie, Maria, & Dreher, n.d). Construct validity is suggested through the correlation between scores of students in grades four and above on the Gates-MacGinitie tests and the Lorge Thorndike Intelligence Tests (Powell, 1969). Split-half reliability for comprehension ranges from .89-.96 and for vocabulary from .88-.93. Because these split-half reliabilities were based on the same community using whichever form was given first, the internal consistency of the test appears to be satisfactory (Powell, 1969). Alternate form reliability over a six-month time interval was also satisfactory: comprehension ranging from .80-.89; vocabulary ranging from .78-.87 (Powell, 1969).

After administering the Gates-MacGinitie test, the students were given a pretest developed by the researcher that included components of literacy dealing with the understanding and use of the cause/effect text structure that would be taught during the instructional program, as well as a pretest of science content about weather. Immediately following the pretest measures, the students were taught the instructional unit. Finally, after finishing the unit, both groups were administered the posttest for the text structure and science content. Each of these test measures was later analyzed quantitatively to determine any statistical differences between the two groups.

Qualitative. Research question 1 and 2, regarding the effectiveness of the program, as well as the third research question, regarding the exploration of how the process of developing and implementing the integrated science and literacy unit impacted my

thinking and practice as an elementary teacher, also required qualitative research strategies. Qualitative research uses interpretive methods, which means that the researcher acts as the research instrument while studying a phenomenon in an open-ended way: developing hypotheses, theoretical explanations, and interpretations as they naturally occur in a situation or regarding a specific phenomenon. Qualitative research relies heavily upon nonnumerical data, where artifacts are collected and observations or interviews are conducted and then recorded in the form of words and/or pictures. These data contain insights and thoughts that are relevant to the researcher in relation to the research questions, and enable the researcher to observe and describe teaching techniques and teacher thinking and knowledge through personal exploration (Johnson & Christensen, 2004; Zembylas, 2005). Recording these insights and thoughts through reflective journaling is particularly useful to increase knowledge of beliefs, values, and practices (Billings & Kowalski, 2006).

In addition to being the collector of the data, I was also the lens through which the data were analyzed. Specifically, I documented my experience as I developed and implemented the instructional program in a reflective journal. Then, I analyzed these data in terms of how my thinking and practice, as an elementary teacher, were impacted. The lesson plans and assessments used specifically for the instructional program (teacher created artifacts) and student work samples (student journals) were also examined qualitatively in order to triangulate the data.

Researcher Stance

My perspective as a teacher and a researcher potentially had an influence on this study and the analysis of the data. I am a single, female, European American who was

raised in a middle-class family in a community adjacent to where the research took place. At the time of the study (2007-2008), I was in my sixth year of teaching elementary school, five of which were in fifth grade. That year was my first year teaching fourth grade. I was conducting this study as part of a Master's program which I was completing at a private university.

In the years that I have been teaching school, I have felt unsure of my ability to help students acquire the basic skills needed to succeed in science. In essence, science has always been a weak topic for me. However, I have consistently felt the desire to improve as a teacher in this area. As I began my fourth year of teaching, I approached colleagues who suggested that one way students might benefit more from science instruction would be to integrate writing into the science instructional units that I was teaching.

In response, I decided to implement the use of a student science notebook. At first, this notebook seemed to fill the gap that was missing in my science instruction. Students appeared to be fully engaged in writing and drawing, and I was sure this would improve their comprehension in science. However, at the conclusion of each science unit, I noticed that the students' test scores did not show any growth and the notebooks that the students were writing in did not reveal to me that their comprehension of science had improved. Pages in the notebook were half-written in, completely blank, or the students had just written definitions of the science terms that they were learning. In addition, the drawings that I had observed the students previously doing were not even in relation to the science topics being studied. As I reviewed these artifacts, I found myself still wondering how to improve students' understanding of science.

While deciding upon the research path that I wanted to take in graduate school, I was, perhaps naturally, drawn to research that has been conducted with science notebooks (Aschbacher & Alonzo, 2006; Nesbit, Hargrove, Harrelson, & Maxey, 2004; Ruiz-Primo, 2004), hoping to find the solution that I was missing in my own implementation of a science notebook. As I sifted through article after article, I realized that maybe it was not only the writing about science that the students were struggling with, but with the reading as well. Because science texts are structured quite differently, I became intrigued with research that has been done to help students become familiar with the structure of informational text (Taylor, 1982; Williams et al., 2004). As a result, I sought opportunities to conduct research in this area.

Participants

Students enrolled in two of three fourth grade classes at Westview Elementary School (pseudonym) participated in this study. The school district in which this school is located is the sixth largest district in the western United States and serves 34 schools in seven communities. The students attending this school come mostly from families with low socioeconomic status, which, according to district sources, means that the annual family income ranges from $13,273-$31,369 (based on a household size of 5). Although this is quite a range of income, the district has defined the low socioeconomic status as such. Many families live in trailer court housing and receive government subsidies. Based on federal guidelines, which offer specifications regarding students' qualifications to receive free or reduced lunch, over 46% of the families in the community with children attending this school are qualified for this government-sponsored program.

Westview Elementary has a total enrollment of 857 students, which includes Caucasian, Hispanic, Pacific Islander, Native American, Black, and Asian students (see Table 1). Students who are Limited English Proficient (LEP) comprise 14.57% of the school total population, 14.22% of the students are enrolled in part- or full-time special education services, and 46.04% of the students receive free or reduced prices on school lunch. District sources report that English is the primary language spoken in 75-80% of the students' homes.

Table 1

School Demographics of Westview Elementary

Demographics	Percentage of Student Population
Ethnicity	
Caucasian	75.48%
Hispanic	21.21%
Pacific Islander	1.18%
Native American	.95%
Black	.71%
Asian	.47%
LEP students	14.57%
Special Ed	14.22%
Free and reduced lunch	46.04%

The participating classes were selected and taught in an order based on convenience for the researcher. The students for whom I acted as the teacher of record were in the treatment group (Class A). These students participated in the three-step strategy instructional program (described below), including both literacy and science instruction. The other fourth grade class (including students who rotated through my classroom for science instruction) acted as the control group (Class B); they received no instruction in the three-step strategy program but received the same science content instruction. This enabled me to make comparisons between the pre- and post-assessment scores of the two classrooms. Class B (control) was taught first in the rotation, and class A (treatment) was taught second. This order of sequence was chosen so that class A might receive the literacy instruction during their literacy block time prior to receiving the science instruction. Working with both groups of students also enabled me to compare and contrast the groups as I investigated the changes that occurred in my thinking and practice over time.

Data Sources

Quantitative. Student pre and posttests were administered at the beginning and the end of the integrated science and literacy instructional unit. Presuming that the two classes were nonequivalent to begin with, approximately 2 weeks prior to the science instruction, a pretest, consisting of two measures, was administered to students in both classrooms (Class A & B). The first instrument, the Gates-MacGinitie Reading Test (MacGinitie& MacGinitie, 1985), offered a sense of the general reading ability of the students. Level 4, form S of this test was administered as a pretest and was used to determine differences in general comprehension abilities at the outset of the study. Since

it was determined that there were no statistical differences in the general reading abilities of the students in Class A and B at the outset of the study ($t_{(45)} = 0.449$; $p = .656$), the Gates-MacGinitie test scores were not used. The second measure, an assessment instrument that I developed, included information components of literacy dealing with the understanding and use of the cause/effect text structure (7 total questions) and science content knowledge (22 total questions). Questions on the instrument involving the understanding and use of text structure were taken and adapted from work on integrating science and literacy from science and literacy educators Smith, Hall, and Losser (2008), and Rhoder's (2002) strategic approach of teaching students to be mindful readers. Questions in the assessment that dealt with science content knowledge contained items pulled and adapted (at a 4th grade level) from the Utah Test Item Pool Server (UTIPS), which is an Internet-based, formative assessment engine for school teachers in the state of Utah (Utah State Office of Education [USOE]). This test contained five true/false questions, six multiple choice, five matching, and three short answer/description questions (see Appendix A for assessment instruments).

Qualitative. In order to evaluate the numerical data obtained from the pre and post testing of the instructional program, questions 1 and 2 required quantitative research methods; however, because qualitative research uses interpretive methods that require the researcher to develop hypotheses, theoretical explanations, and interpretations, qualitative support to questions 1 and 2 was also necessary (Johnson & Christensen, 2004). Additionally, inasmuch as question 3 required a description of the journey that I took throughout the process of developing and implementing the instructional program, a qualitative approach was also necessary to address this question. Thus, I kept a daily

reflective journal describing the thoughts and experiences that I had throughout the development and implementation of the three-step strategy instructional process. This journal reflected my thinking about the program's effectiveness. I specifically wrote about any changes in my beliefs and instructional practice that occurred. Other data sources for this portion of the investigation included teacher-created artifacts, including the lesson plans and assessments that were developed, as well as student work samples, where students recorded their observations of experiments conducted and their practice with the text structure strategy in a journal.

Procedures

Science in 4th grade at Westview Elementary is typically taught on a rotation schedule, where each teacher in the fourth-grade team develops and teaches one of three units to all of the students, one class at a time. Students in each class rotate through each instructional unit on a 21-day rotation schedule. For the purposes of this study, I developed and taught lessons from Standard II of the *Fourth Grade Utah State Science Core Curriculum* (USOE, 2002). This standard states that "students will understand that the elements of weather can be observed, measured, and recorded to make predictions and determine simple weather patterns" (p. 7).

The Three-Step Strategy Instruction Program

Research indicates that all students benefit from explicit strategy instruction (Alexander, 1996; Cambourne, 1999; Purcell-Gates, 2007; Rhoder, 2002; Williams et al., 2004). This type of instruction engages students in lessons with a variety of literacy materials where they are provided appropriate modeling of strategies to help with text comprehension (Kragler, Walker, & Martin, 2005). In order for students to become

motivated users of these strategies, they need "systematically orchestrated instruction or training" (Alexander, 1996, p. 90). The three-step strategy instruction model, described by Rhoder (2002), is an approach that instructs students how to be mindful strategy users while reading and learning about text structure in a content area. For this study, after the students in both classrooms were administered the pretest, the three-step strategy instruction program was then implemented in Class A. This program is described below.

Rhoder (2002) modified Prawat's (1991) model of advocating two steps to strategy instruction with a focus on fostering mindful learning and reading: direct instruction in the text structure strategy followed by immediate practice using curricular content area materials. While Prawat's approach seemed warranted to address the problem of students' ability to transfer the knowledge of using text structure to aid them in becoming mindful readers, Rhoder (2002) added an additional intermediate step (relating to content and curriculum) between the direct strategy instruction and curriculum practice. This step was added, Rhoder (2002) argued, so that students might have practice with text structure within a familiar content. This additional step further facilitates transfer, which is the ability to take instructional strategies learned and then make use of them in another context. In summary, this three-step strategy instruction is as follows: (1) direct instruction in the text structure strategy being used, (2) practice with the text structure within a familiar content, and (3) practice with the text structure using curricular content area materials. This version of the strategy instruction was used in this study.

Rhoder (2002) stated that one way for students to become mindful readers is for teachers to help them understand and recognize the structure of a text. The term "text

structure" refers to an author's pattern of organizing or arranging a text (Ciardiello, 2002; Dreher & Singer, 1989; Neufeld, 2005) in order to help the reader make sense of what is written. As previously mentioned, authors of informational text compose using a variety of different text structures. The most common ways to organize informational text are: description, temporal sequence of events, explanation of concepts, definition and example, compare/contrast, cause/effect, and problem-solution-effect (Armbruster et al., 1987; Bakken & Whedon, 2002; Brooks et al., 1983; Ciardiello, 2002; Dreher & Singer, 1989; Montelongo, et al., 2006; Neufeld, 2005; Williams, 2005).

The informational text structure "cause/effect" was the literacy focus in the three-step strategy instruction process for this study. Authors using cause/effect text structure do so in order to explain how actions or events cause something to happen (Alvermann et al., 2004). This specific text structure was selected because I determined that it would fit well with the science content selected for the instructional unit. The concepts involved in learning about the weather involve relationships of cause/effect; thus, teaching this literacy strategy and concepts about weather seems to be a natural connection.

Throughout informational texts, authors use syntactic clues (referred to as signal or key words) pertaining to each specific text structure to help readers understand how ideas are related (Alvermann et al., 2004). Through the use of key words in this text (e.g. reasons why, as a result, because, if…then, since, causes, this led to), students are able to identify and analyze causes and effects in well structured paragraphs (Alvermann et al., 2004; Williams et al., 2007). For example, a cause/effect example using a key word involving elements of the weather might include the following sentence: "A hurricane struck your town and, as a result, it severely damaged property and caused flooding." In

this instance, the key words “as a result” and “caused” were used to signal the reader of the effects that the hurricane caused.

Treatment Group

The students for whom I acted as the teacher of record were included in the treatment group (Class A) and received instruction in the three-step strategy program, as well as regular science content instruction. The other fourth grade class (including students who rotated through my classroom for science instruction) acted as the control group (Class B) and received no instruction in the three-step strategy program; however, they received the same science content instruction.

The students in the treatment group (Class A) received instruction related to the cause/effect text structure in three steps (see Appendix B for the three-step strategy approach on text structure instruction). Two weeks prior to the science instruction, during the literacy block, I taught these students the first two steps of the three-step process. First, the students were taught explicitly about text structure. The term explicit refers to the way that a lesson is delivered. Explicit instruction is not merely mentioning a concept. Instead, a teacher deliberately demonstrates and gives specific examples (Cambourne, 1999; Mesmer & Griffith, 2005; Pearson & Dole, 1988) relating to the skill or concept to be learned.

The first step was immediately followed by student practice using curriculum-free examples of the cause/effect text structure. A curriculum-free example includes something that comes from everyday experience. For example: Jeffrey fell down. As a result, he scraped his knee, started crying, and called for help. In this example, students are able to identify the cause and effect through the use of the keywords, “as a result.”

Jeffrey fell down (cause), scraped his knee, started crying, and called for help (effects). Approaching the cause/effect text structure in this curriculum-free way allowed students the chance to focus just on learning the attribute of the text structure, without having to worry about new content knowledge at the same time.

For the second phase in the three-step process, the students were given content-bound, curriculum-free practice on the cause/effect structure. This means that the texts were simple, yet of familiar science topics, and were in a discipline-based text that was not part of what the students were currently learning in school (Rhoder, 2002). For example, the students in fourth grade practiced identifying the cause and effect in a text that they used in third grade where they learned about animal extinction. In this instance, the text was content bound (science); however, it was termed "curriculum free" because the students had previously studied this curriculum and therefore were familiar with it. This allowed them to focus on the structure of the text itself, without having to learn new content as well.

The final phase of the three-step strategy instruction process was implemented during the science instruction rotation. During this phase, students in the treatment group had curriculum-bound content area practice using the text structure. This means that the instruction in text structure was embedded in the texts of their current science curriculum. This third step allowed the students in the treatment group the chance to transfer what they had learned about text structure to aid them in learning about their current science topic, weather. It was here that students identified causes and effects in their texts about the weather, as well as created cause/effect text using the skills that were taught to them

in Step 1 and 2 of the three-step strategy instruction process (see Appendix C for other examples of curriculum content area bound instruction).

Control Group

Students in the control group (Class B) were not taught the three-step process but received the science instruction without the text structure instruction. At the end of the science unit, the students in both classes (Class A and Class B) were given the posttest. This posttest included information components of literacy, use of text structure, and science content knowledge (see Appendix D for posttest).

Data Analysis

The Gates-MacGinitie test scores for the treatment and the control group were compared using a *t*-test for independent samples. This test was used specifically to investigate the differences between the means of the two groups independent of one another before the start of the study and after its conclusion (Salkind, 2004). Since it was determined that the general reading abilities of the students in Class A and B were not statistically different at the outset of the study ($t_{(45)} = 0.449$; $p = .656$), the Gates-MacGinitie test scores were not used as a covariate. Instead, the pre and posttest means of the researcher-developed assessments for the two groups were compared using Analysis of Covariance (ANCOVA) with the pretest as a covariate. ANCOVA is used to analyze possible difference in group means. This statistical method of analysis is used to equate groups that are found to differ on a pretest or some other variable or variables, and is most appropriately chosen for a specific study when more than two tests are given (Johnson & Christensen, 2004). In my case, the students took 2 tests-the pre-content, and the pre-text tests. The pretests provided information about differences that might have

existed between the treatment and control group before my research was conducted. These pretests were then used as a covariate to statistically equalize these initial differences between the groups.

Qualitative data should be analyzed in two different contexts—the context in which the research materials were developed, as well as the context in which they were used for research purposes (Gall, Gall, & Borg, 2003). As the data are read and reread, certain words, phrases, or themes may stand out in the data that is collected in qualitative research (Bogdan & Biklen, 1998). Thus, for this study I examined three sources of data in order to identify themes related to the research questions: a reflective journal, teacher-produced artifacts (lesson plans and assessments), and student work samples.

Throughout the study I recorded the experiences and thoughts I had while developing the instructional materials in a reflective journal, as well as those I experienced during the actual implementation of the instruction. Upon completion of the instructional unit and testing process, I reviewed my reflective journal describing the thoughts and experiences that I had throughout the development and implementation of the three-step strategy instruction process with students. This qualitative approach to reviewing the data allowed me to look for common themes and patterns of significant influence on the research conducted in this study that were specifically related to student learning and any changes in my thinking and instructional practice. As I did this, I also looked for areas of convergence with the quantitative data through highlighting specific phrases in the journal that I felt were of particular importance to any successes or failures the students had with the text structure and science content learning as well as my responses to these events.

In conjunction with this analysis of my reflective journal, I reviewed the teacher-created artifacts and the student work samples created throughout the course of this study. It was here that I searched for specific aspects in the lessons that I felt contributed to students' ability to understand science concepts using the cause/effect text structure. Thus, these three distinct sources were used to triangulate the data, ensuring the rigor of data analysis (Johnson & Christensen, 2004).

In a final effort to ensure the rigor and accuracy of the analysis, I searched through all three sources of data for disconfirming evidence—data that might conflict with the identified themes. No disconfirming evidence was found.

Limitations

Several limitations to this study should be addressed. First, the nature of this study did not provide for full control of potential confounding variables, primarily because it did not randomly assign participants to comparison groups. Second, as the researcher, I was also not involved in the literacy instruction that the control group received. This means that I was unaware of any literacy strategy instruction related to text structure awareness that the students were exposed to with their own teacher. Third, the small number of participants and a limited 4-week instructional period may also have contributed to the limitations of this study. Finally, inasmuch as I was the teacher and also the researcher and developed the lessons on my own, this may also have posed a limitation where validity and reliability of the pre- and post-unit assessment instruments could have been a problem. To address this limitation, two university professors (science educators) reviewed these assessments to check for content validity.

CHAPTER 4

RESULTS

The purpose of this study was to answer three questions: (a) What effect does explicit instruction designed to enhance students' awareness and understanding of expository text structure (e.g., cause/effect) have on student learning in science? (b) What effect does this instruction have on students' ability to identify and use this text structure? and (c) What changes in teacher belief and instructional practice occur as a result of developing and implementing an integrated science and literacy unit that explicitly teaches text structure awareness as a means of enhancing students' science content knowledge? What follows in this chapter is a discussion of the results of this research in terms of the students' ability to recognize and correctly use the cause/effect text structure and understand science content, as well as how the journey has impacted me, as a teacher. The first section, *Text Structure and Student Learning in Science*, addresses questions one and two and presents the results of the quantitative data analysis. The second section of this chapter, *My Beliefs and Practice*, addresses all three questions based on qualitative data analysis.

Text Structure and Student Learning in Science

Students enrolled in two of three fourth grade classes at Westview Elementary School (pseudonym) participated in this study. There were 24 students included the treatment group (Class A) and 23 students who participated in the control group (Class B). To investigate the first two research questions, regarding the effectiveness of the instructional program on student learning in science, as well as their ability to identify and use the text structure, quantitative research methods were used. The comprehension

subtest of the Gates-MacGinitie Reading Test (MacGinitie & MacGinitie, 1985) was given at the beginning of the study in order to determine any statistical differences in the general reading comprehension abilities of the two groups. The means of the two classes' scores on the Gates-MacGinitie Test were compared using a *t*-test for independent samples. No statistically significant difference was found ($t_{(45)} = 0.449$; $p = .656$). Because of this, the Gates-MacGinitie test scores were not used; rather, the pre and posttest means from the researcher-developed assessments for the two groups were compared using ANCOVA with the pretest as a covariate. The results revealed that the treatment group scored significantly higher than the control group on the science content posttest ($F_{(1, 44)} = 12.740$; $p = .001$) and on the text structure posttest ($F_{(1, 44)} = 1241.089$; $p = <.001$). Descriptive statistics are shown in Table 2. Due to the fact that the control group (Class B) was not taught about text structure, this latter score was to be expected. Both classes, however, received identical science content instruction, except for the addition of the text structure instruction that occurred within the treatment group (Class A).

Table 2

Descriptive Statistics for Content and Text Structure Tests

		Content		Text Structure	
Group	*N*	*M*	*SD*	*M*	*SD*
Treatment	24	18.58	2.81	34.58	2.64
Control	23	15.43	4.36	4.74	3.96

The results of the content and text structure posttests analysis suggest that the students' increased awareness, understanding, and use of the text structure may have had a positive impact on their science content knowledge.

My Beliefs and Practice

In addition to the quantitative research methods used in this study, qualitative research methods were used to interpret the impact of the research on teacher thinking and practice, as described previously. A review of my reflective journal describing the thoughts and experiences that I had throughout the development and implementation of the three-step strategy instruction process allowed me to gain a better sense of the effectiveness of the text structure program with the students. Additionally, a review of the teacher-created artifacts (including the lesson plans and assessments that were developed for the instructional unit) and student work samples helped to provide insights and understanding that might have been missed if only a single research method would have been used in this study. The use of multiple data sources enabled triangulation of data, thus ensuring the rigor of data analysis.

Reflective Journal Review

Analyzing the qualitative data required several steps or stages. First, so that I could get a general feel for the experience I had, as a teacher, throughout the planning and implementation of the instructional program, I read through my entire reflective journal one time. While I did so, I used a highlighter to note certain phrases I had written that stood out to me that I felt were of particular importance relating to the students' successes and failures in their science and text structure learning. I also highlighted

thoughts and impressions I had throughout the instructional process in relation to changes I was experiencing as a teacher.

After the initial reading of the reflective journal, I re-read each entry separately in conjunction with reviewing the lesson plans and student work samples associated with each lesson. During this stage of analysis, I first looked specifically at each lesson that was planned and what my responses to each of the lessons were—if I felt they were effective or not, and what changes in my belief and practice occurred as a result of developing and implementing the program (research question 3). Next, I reviewed the treatment group's student work samples to see the effect that the explicit text structure instruction had on student learning and their ability to use the text structure on their own (research question 2) as well as how the instruction affected the students' science content knowledge (research question 1). Reviewing the data in this way allowed me to examine more specifically how the students' awareness and learning of the cause/effect text structure and science content through the implementation of this program were affected.

Finally, I typed each highlighted phrase and then searched among them for emergent themes related to student learning and my beliefs as a teacher. From my reflective journal, the teacher-created artifacts, and student work samples, six consistent themes emerged. I will first reveal each of the themes and thereafter elaborate on the meaning of each one, as well as how they emerged from the data individually. Themes a-c attend to text structure—the literacy strategy itself: (a) meaning and purpose of text structure, (b) students' science learning and text structure support, and (c) successes and struggles with the use of the text structure. Themes d-f relate to my thinking about teaching. In particular, these themes emphasize ways I improved or wanted to improve

my teaching: (d) science teaching efficacy, (e) benefits of inquiry, and (f) desired changes. Using these six themes, I then sorted the typed reflection journal phrases according to each theme's relationship to the three questions pertaining to my study.

What follows is a description of each of the themes that emerged throughout the data analysis. The descriptions of the themes will be discussed in two sections. I will begin by discussing the themes that emerged in relation to the literacy strategy—the students' and my journey with text structure. Next, I will elaborate on the themes relating to my teaching practices—the experiences I had as a teacher while new instructional practices were adopted into my science instruction.

The Literacy Strategy

Again, this section addresses all three research questions based primarily on the qualitative evidence, which gives more depth and support to the quantitative findings described earlier. Indeed, these findings shed additional light on student learning, providing additional evidence that students' knowledge of science and their understanding of the literacy skill improved.

Three themes emerged from my reflective journal in relation to the literacy strategy itself (text structure). The following section will define each of the themes individually, followed by linked representative quotes from my reflective journal that provide evidence for the emergence of each theme.

Meaning and purpose of text structure. This specific theme surfaced in my journal from several experiences I had through preparing the instructional program and the changes that took place in my thinking as a teacher (research question 3). One of the changes that I experienced was that as I looked at different texts, I began to realize for

myself that the text structure really was there—something I had never noticed before as a student, or paid much attention to as a teacher. In one reflection I wrote, "I have been able to see some interesting things while looking for texts. I can see the text structure. . . . I've never been able to see that in texts before now" (Reflective Journal, 07/30/07). Several times throughout the planning of the text structure instructional unit, my mind reverted back to an important learning experience I had had specifically with text structure while I was attending college as a freshman:

> In 1994, I took a Psychology class and the text assigned was the hardest textbook I had ever read. I remember getting so confused, and felt like I just didn't understand the language of the text. I was often overwhelmed. Every test I took, I got between a D and an F, and just didn't know what to do. I decided that I really needed to learn to memorize what I had read because somehow the information needed to stick in my mind better. And so, as I read each paragraph in my textbook, I would rephrase it in my own words and write it on the left or right-hand margin in the book directly. After finishing a chapter, I would re-read my own representations of the text to prepare for the test. I was then able to pull A's on each of the tests I took for the rest of the semester. What I was doing was picking apart the [structure of the text]. Interesting how that relates to my study. (Reflective Journal, 09/10/07)

Meanwhile, in the midst of conducting my research and reading other areas of research related to my area of study, I came across a quote that seemed to point out a solution and really sum up what I needed as a freshman in college. I recorded it in my reflective journal:

> To comprehend what we are taught verbally, or what we read, or what we find out by watching a demonstration or doing an experiment, we must invent a model or explanation for it that organizes the information selected from the experience in a way that makes sense to us, that fits our logic or real world experience, or both. (Osborne & Wittrock, 1983, p. 493)

As I read these entries, not only did I remember and feel like I could relate to how it feels while reading a text that is difficult to understand, I felt that this study was suddenly more poignant to my own journey as a changing teacher (research question 3) and how knowing about text structure at that age would have been so beneficial to my learning. As I began to realize the meaning and the purpose of text structure, I noted, "Maybe my noticing it will also be something that the students start to do, and it will benefit their lives in the long run, giving them strategies to use when stuck reading like I was in my Psychology class back in 1994" (Reflective Journal, 07/30/07).

The documentation of my perspectives and personal views about the meaning and purpose of text structure allowed me to see the profound impact that understanding text structure had on me, as a young college student. I suspected also that it would benefit my students' learning. The results of the content and text structure posttests supported this assumption, documenting the students' increased awareness, understanding, and use of the text structure and improved science content knowledge.

Students' science learning and text structure support. This theme was evident throughout my reflective journal. Indeed, I noted multiple areas in the science content instruction with Class B (control group) where I felt text structure support would have been very beneficial to the students' science learning (research questions one and two).

However, because the control group was not going to receive any text structure instruction, I could not change any of my instruction because I was in the middle of gathering data for my research. In one of the reflections, I noted, "In this severe weather lesson where they actually learn about the causes and effects, [I think] text structure support would really [have enhanced] their content knowledge" (Reflective Journal, 02/04/08). In another lesson given on clouds, I wrote, "I realized that this would have been a perfect lesson to implement some text structure instruction . . . they could have used the extra support here, definitely" (Reflective Journal, 02/07/08). After reviewing another lesson, I realized that other text structures—not just the cause/effect structure—would have been beneficial to the students' learning. I said,

> Where could text have been supported here? I think this is where different text structures would [have been] of great value . . . I wish I had the option of a few structures to [teach] . . . not always having to fall back on the one option [the cause/effect structure]. Next year, I will love teaching my students about all of the structures. (Reflective Journal, 03/11/08)

While implementing the text structure activities in conjunction with the science content instruction, I realized that there were many activities I did not like, and that if the students would have been given additional text structure support, the lessons may have been more beneficial to the students' learning. At times, I felt that the lessons were full of "fluff," meaning I wished that I had dug deeper into science content and text structure—therefore allowing my students to have a better science learning experience overall. One of the reflections I wrote reveals the frustration I felt and the wish that I could have done something different for the students. I noted,

> I actually do not like this activity at all. This has nothing to do with demonstrating science content, but to just have the ability to "listen well." I knew right off it wasn't working. . . . What could I have done differently . . . where the students could have taken apart [and learned from] text? (Reflective Journal, 03/13/08)

The experience I had teaching Class B (control) really allowed me to see how much the students would have benefited from extra support in learning how to negotiate the structure of the text. After realizing for myself the importance of text structure, it seemed clear to me that this knowledge would have enhanced the students' science learning experience (research questions one and two). Providing added text structure support may have allowed the control group students' to perform better on the posttests.

Successes and struggles with the use of the text structure. This theme describes instances throughout the implementation of the instruction where I saw students in the treatment group identify and use the cause/effect text structure successfully on their own, instances where either the students struggled with the use of the text structure, or I felt that the instruction I had planned was not as effective or thorough as I wished it would have been (research question 2). Near the beginning of the text structure instruction, when the students were just learning about what text structure was (see Appendix B), I noticed that the students were able to easily understand and successfully use the structure with familiar, everyday topics. For example, one pair of students wrote, "I left the oven on [and], as a result, the house caught on fire." Another pair wrote, "I got a paper cut [and], as a result, I started bleeding." After observing the students create these cause/effect sentences, I then noted in my reflective journal, "It was so easy for the students to create cause-effect sentences . . . especially because it had nothing to do with

any curriculum-type information. Their sentences were very creative and individual to each student. I could tell that this was a great beginning" (Reflective Journal, 02/26/08). Other instances of successes noted in my reflective journal were, "[The students] spotted keywords automatically" (Reflective Journal, 03/06/08) and "The students seemed very comfortable with the keywords" (Reflective Journal, 03/07/08), as well as, "Some of my students are automatically using the text structure [in another science unit] and we haven't even started implementing this into the [weather] unit! What success!" (Reflective Journal, 03/10/08).

In addition to the successes the students were experiencing, at times near the beginning of the text structure instruction, I also noticed that they encountered some difficulties, and there were also some things I wished could have been done differently. For example, in one reflection I wrote:

> The students seemed to find the effects on the worksheet that I provided them, and were able to share some examples with each other, but I almost wish that I would have had them work individually on some—just to see if they really understood [on their own]. Would having them create their own causes and effects been more beneficial to their learning? Was providing them with my own examples hindering [them] in a way? (Reflective Journal, 02/27/08)

As the students moved from the first to the second step of the text structure instruction—from recognizing the text structure, to recognizing and using keywords, to mapping out paragraphs, and then to summarizing—I reflected, "As I taught lesson 4 today—summarizing and mapping—I wondered if there should have been a lesson itself

on summarizing. It seemed as if the students didn't know how to put things into their 'own' words" (Reflective Journal, 02/29/08). The next day I continued,

> Students responded well to a review of keywords and mapping, but summarizing is a real struggle for them. . . . I wonder if this [lesson] should have been excluded from the study. What benefit is it doing for them . . . should I have included this . . . will it hurt them . . . it almost seems as if when they go to summarize, they are just kind of regurgitating it back out again. I always have felt that summarizing is a way for [students] to tell in their 'own' words something [they read], and yet it seems that in this unit, they really aren't using their own words to summarize, but the words written in their maps. (Reflective Journal, 03/04/08)

Prior to implementing the text structure practice into the science unit (Step 3 of the text structure instruction), I was curious to see if what the students had learned in the first and second step of the text structure instruction could be transferred successfully and used in the curriculum that we were studying at the time. In one reflection I noted,

> We were playing a memory game for review, and the two items that were chosen by one of my students were "rising temperatures and evaporating." [Curious to see if the text structure instruction was positively affecting the students], I asked if a few students could put together a cause/effect statement, and several of them were able to. They formed statements like, "Rising temperatures cause water to evaporate," and "The temperature rises, and as a result, water evaporates." I also noticed how one student, when forming a cause/effect statement with multiple effects, caught herself using "as a result" twice, and hurried [to] change her

keyword so that her statement didn't have the same keywords in it. What success! (Reflective Journal, 03/07/08)

Later, while implementing the text structure instruction into my science unit, I noted many instances when I was able to see that students were not only learning to use the text structure on their own (research question 2), but I saw that it was positively affecting their ability to learn and remember new science content (research question 1). Phrases in the student work samples, such as "It was raining and snowing [and] this led to the thermometer [going] way down from where it was" and "The water droplets became heavy in a cloud and because of this, it started to rain," reinforced to me that what the students had been taught about text structure and the use of keywords had positively influenced their ability not only to remember new science content, but speak what they had learned about science in a way that made sense. At the end of the instructional unit, the students were then given a posttest on what they had learned about text structure and weather. As I observed the students taking their tests, I noted,

> I was so excited to see [the students] not moan and groan about the text structure part and not knowing how to do it like they did in the pretest—they knew exactly what to do, and they looked so confident in doing it! They knew how to construct smooth sentences and how to map out causes and effects easily. (Reflective Journal, 04/04/08)

The students were asked in the posttest multiple times to create cause and effect statements on their own. There were several clear and direct examples that stood out to me from their tests directly that further reinforced the fact that the students had benefited from the instruction, such as "It was a nice shiny day. At 2:00 [two] gigantic black clouds

rolled over the town [and] it started to snow. As a result, the thermometer fell" and "A tornado was at Texas. As a result, it destroyed the houses. It caused trees to tip over, and then crops died and there was no food left [for the people]."

As stated previously, the students in the control group were not taught about text structure awareness and therefore did not benefit from that instruction. As I reviewed their student work samples and final assessments, I noted that these students were not as "fluent" when they wrote about scientific content as the treatment group was. In other words, the depth of conceptual understanding and the ability to describe that knowledge differed by group. For example, when asked to explain how precipitation forms, students in the control group wrote sentences such as, "I think vapor hits something cool and it rains," or "The clouds get really heavy, I think, and the water falls out." In contrast, students in the treatment group, who had benefited from the integrated instruction incorporating both science content and text structure instruction, wrote more complete science ideas or concepts such as, "Water evaporates and then hits cold dust particles in the air. This forms a cloud. When the cloud gets too full, it precipitates," or "When water vapor rises into the sky, it mixes with cold dust and then condenses and makes a cloud. When the cloud gets too full, it precipitates and then, depending on the temperature in the sky, it rains, snows, sleets, or hails." Additionally, as I reviewed the text structure posttests, I also noted differences in the groups' scientific "fluency." When the students were asked to explain the effects of a tornado, for example, students in the control group wrote brief, undeveloped responses such as, "A tornado wrecks stuff" or "A tornado injures." In contrast, children from the treatment group were able to express themselves in much more descriptive, complete sentences with well-developed ideas. Again, this

suggested that these students had developed a deeper understanding of the science content as well as better skill in describing their knowledge. Students wrote: “A tornado came to Denver. As a result, a lot of houses were damaged. This led to a lot of people [getting] injured,” and “A tornado came to Utah, and as a result, trees broke, people got severely injured, and all of the schools had to shut down.”

In sum, as I reread the student work samples in conjunction with my reflective journal and the quantitative results of the tests, it became even more clear to me that the explicit instruction that was designed to enhance students’ awareness and understanding of expository text structure indicated a positive effect on their ability to learn science content and to successfully identify and use the text structure on their own (research questions one and two). In addition to these successes, as a teacher I was able to recognize how teaching students about text structure can greatly enhance my science instruction and, therefore, benefit my students—allowing for a better science teaching and learning experience overall (research question three).

My Teaching Practices

In contrast to each of the themes discussed to this point, this section is specific only to answering the third research question. Three themes emerged relating to my teaching practices—the experiences I had as a teacher while new literacy instructional practices were adopted into my science instruction. The following section will define each of the themes individually, followed by linked representative quotes from my reflective journal that provide evidence for the emergence of each theme.

Science teaching efficacy. Perceived self-efficacy has been referred to as “beliefs in one’s capabilities to organize and execute the courses of action required to produce

given attainments" (Bandura, 1997, p. 3). Defining the sources of information from which self-efficacy beliefs are constructed, Bandura (1997) states,

> Self efficacy beliefs are constructed from four principal sources of information: enactive mastery experiences that serve as indicators of capability; vicarious experiences that alter efficacy beliefs through transmission of competencies and comparison with the attainments of others; verbal persuasion and allied types of social influences that one possesses certain capabilities; and physiological and affective states from which people partly judge their capableness, strength, and vulnerability to dysfunction. (p. 18)

The theme of science teaching efficacy was evident frequently in my reflective journal throughout the planning and implementation phases of the instructional unit. According to Bandura's (1997) four principal sources of information, the type of self-efficacy that emerged in my study was enactive mastery experience. Bandura (1997) states, "Enactive mastery experiences are the most influential source of efficacy information because they provide the most authentic evidence of whether one can muster whatever it takes to succeed" (p. 80). Studies suggest that inadequate content and pedagogical knowledge decreases teachers' self-efficacy and negatively impacts student understanding (Bandura, 1993; Borko & Putnam, 1996). I recognized this to be true for my thinking about teaching science. While planning the lessons for the text structure and science content, I noted repeatedly that my own knowledge of science was inadequate and felt at times that I did not have "what it took to succeed" as a teacher of science. I wrote, "I think one of the biggest problems teachers face is [their own] self efficacy. [I feel like] my insufficient

knowledge about science really has now and in the past made it harder to [feel like I could] teach effectively to my students" (Reflective Journal, 01/10/08).

Throughout my reflections, I reflected on my own experience as a student and then, later, as a teacher of science. I wrote, "Choosing science as an area of research was perfect for me, because it was always a weak area of mine" (Reflective Journal, 08/27/07) and "Science was always my worst subject growing up—interesting that now I am supposed to 'teach' it to my students. I feel like my knowledge is inadequate to do this at times" (Reflective Journal, 01/08/08). Frequently my reflections included negative phrases related to my own low science teaching efficacy, such as, "Can I really expect my students to do well if I don't know, or am not sure of the science concepts myself?" (Reflective Journal, 01/29/08), "My [insufficient] knowledge of [the topic of study in science] shouldn't affect them in a negative way, but should help them, and as a teacher [I feel] that I should be doing more to make that happen" (Reflective Journal, 04/03/08). "Sometimes I feel like my science knowledge, or my ability to teach it gets in the way of science learning. I feel like at times, I interfere [with student learning]" (Reflective Journal, 4/01/08).

One particular experience related to science teaching efficacy resurfaced over and over throughout the study. While in my first year of teaching school, I had a unique learning experience while teaching science to my 5th graders. I was attempting an experiment in front of my students that I had obtained from a teacher's manual on electricity. At one point in the middle of the experiment, one of my students said, "Have you really tried this?" (Reflective Journal, 08/20/07). While thinking about this experience, I wrote the following in my reflective journal:

> I often think about all of the times I have just "winged" a science lesson—mostly because I felt inadequate at teaching it, or my knowledge wasn't sufficient. That student's comment during my first year of teaching in one of my science lessons has and will always stand out to me. I want to make sure I've always "tried it." (Reflective Journal, 08/20/07)

Regardless of the insufficient knowledge that I felt I had early on in my science teaching or my inability to effectively teach it, however, I recognized that choosing this area of research was the right path to take for me, and that "It has deepened my desire to perfect this area and made me feel more confident in doing so" (Reflective Journal, 08/27/07). Through the successes I observed as a result of this integrated science and literacy unit, I gained confidence in the fact that what and how I had taught my students had actually worked. This newfound confidence allowed me to have 'enactive mastery experiences', as Bandura (1997) states. Thus, where I used to feel deficit in my ability to effectively teach science, I now feel assured that I have 'what it takes to succeed' (1997).

Benefits of inquiry. Although not specifically related to using text structure to enhance students' understanding of science content, the idea of using "inquiry" as a way of teaching science was a frequent theme found in the journal. Inquiry has been defined as "the work scientists do when they study the natural world, proposing explanations that include evidence gathered from the world around them" (NRC, 1996, p. 23). The term inquiry has also been used to describe a powerful way of teaching and learning science in the classroom, modeling the work of scientists (Anderson, 2002; Southerland et al., 2007). There were often moments in my reflections that I wished I had had a different science activity in place of the one that I had planned, one where true inquiry could have taken

place. At times, I felt that I wasn't allowing my students to have rich enough science learning experiences. One of my reflections stated, "Is there a better way here that the students can actually have a hands-on activity?" (Reflective Journal, 02/05/08) and later "How could I have made this more real to them—where can I dig deeper as a teacher to [more effectively] teach my students?" (Reflective notes, 02/06/08). Feeling that I needed to allow more inquiry-based lessons into my own science teaching, I wrote the following:

> [I feel like sometimes] I try to force knowledge on the students—just because I know a certain experiment is supposed to work on a certain topic—instead of letting them experience it [and] involve themselves in it, I want to have them all come up with the same conclusions. (Reflective Journal, 04/01/08)

As I reflected upon the science content lessons I had planned for the instructional program, there were a number of instances where I described the activities that I was having the students do as "fluff." What I meant by this in my journal was that I felt that some of the lessons that I had prepared for the students were not lessons that really helped the students in their science content learning. Instead, they were of little substance or did not teach content very well. In one particular lesson about wind, the students made a wind vane and went outside to test the wind to see how their wind vane worked. I noted,

> The lesson today on wind was one of those "fluff" lessons that I've been talking about. The students seemed to make this little art activity more of a play activity. I wish maybe here I would have brought in some real wind vanes, taken the students outside, [and then let inquiry take place]—let them observe how they worked, and given them the opportunity to see that using a tool such as a wind vane can really help us predict the weather. (Reflective Journal, 02/06/08)

At one point in the implementation of the instructional program I thought about my own learning during my graduate work and how it had influenced my notions of omitting "fluff" from my teaching. I recalled that near the beginning of my graduate work I had spent a vast amount of time reading and learning how to read research articles. One poignant phrase from my journal emphasized a new way of thinking about science instruction: "Evaluating research articles in the graduate program really has made me realize the importance of true, tested things that I can implement into my [science] instruction, instead of the 'fluff' that [I sometimes use]" (Reflective Journal, 08/27/07).

While reflecting about inquiry, I realized that maybe I had just never experienced inquiry myself, and that having the opportunity, as a teacher, to observe what inquiry really is would definitely benefit my teaching and therefore make me a more effective teacher (Reflective Journal, 01/18/08). In addition to my desire to implement inquiry-based lessons more into my teaching, I also reflected on the fact that changing my teaching to reflect more inquiry-based lessons would definitely require a lot of work, time, and effort. About this I said, "I just wish that, as a teacher, I had greater amounts of time and also the energy to prepare like I really need to for these students. Can this change take place like I would like it to just from the hours I am at work?" (Reflective Journal, 01/17/08). Later on in my journal, I again reflected on my desire to change my science teaching:

> Now [it is] my task [to know] what to do with this knowledge. Next year, I will have so much more structure and more ideas. As I look for inquiry and research-based lessons to implement, things will change [in my instruction] and I will eliminate more "fluff" from my teaching and add more "meat." It's really

> important every year that as a teacher I [change for the better] to help [benefit my students]. (Reflective Journal, 03/24/08)

Desired changes. This theme became apparent throughout my reflective journal as I often expressed the desire to reform my teaching due to the successes and failures I experienced while literacy instructional practices were adopted into my science instruction. Implementing these practices has had a profound impact on my thinking and my desire to change my practice for the better. Lemke (1997) asserts that as we take opportunities to participate, we change. Mooney (1957) also addresses this idea, speaking of the inner realization and the changes that can take place while involving oneself in research when he wrote,

> Research is a personal venture which, quite aside from its social benefits, is worth doing for its direct contribution to one's own self-realization. It can be taken as a way of meeting life with the maximum of stops open to get out of the experience its most poignant significance, its most full-throated song. (p. 155)

The data suggest that as I have involved myself in research-based teaching, "[my eyes have been opened] to a whole new way of teaching" (Reflective Journal, 08/13/07). The lesson preparation at the outset of the study really had a positive effect on me—knowing that I had tried hard to prepare well thought-out lessons, I noted that it had made my instruction better and more refined (Reflective Journal, 09/21/07). As I reflected on the impact of planning and preparing the lessons, I wrote,

> In the end [this will have] saved me so much instructional time—the students will learn more in a concentrated amount of time, and less time will be spent on

wasted “fluff” that usually occurs when teachers are unable to prepare enough due to their lack of time and lack of knowledge. (Reflective Journal, 01/10/08)

As I reviewed the journal entries, searching specifically for what changes occurred as a result of implementing this program, several statements stood out to me that suggested personal benefits of conducting this research. For example, I wrote that this opportunity allowed me to “become a better teacher, more reflective, more in tune in a professional way on what things I needed to do to change” (Reflective Journal, 02/12/08). Journaling my experience also had a huge effect on me, and I wrote that I wished I always had the time to reflect and evaluate my teaching as I did throughout the study. I also noted that reflecting on my instruction would continue to improve my teaching even more, not just in the writing, “but the reviewing. For even now, as I go back and look at what I have been writing about, it has changed me as a teacher already by giving me [ideas on how I can improve my instruction] for next year” (Reflective Journal, 02/11/08).

One of the purposes of this study was to investigate the changes that occurred in my thinking and practice as I implemented an “integrated” literacy instructional program into my science instruction. As I reviewed my reflective journal, I noticed that I did not specifically state any thoughts that I had about this science-literacy integration, yet several of my entries spoke of the benefits that text structure awareness had on the students’ ability to learn science content. As previously mentioned, I noted that science was an area that I felt “inadequate” to teach in the past and that choosing science as an area of research has “deepened my desire to perfect this area and made me feel more confident in doing so” (Reflective Journal, 08/27/07). Choosing to implement literacy strategies into my science instruction and seeing the great effect that it had on my

students' ability to learn science content has opened my eyes to the importance of integration.

In summary, through the use of a mixed methods approach (combining quantitative and qualitative methods) I was able to more completely explore each of my research questions. Quantitative research methods enabled me to investigate questions 1 and 2. The statistical results of the content and text structure posttests suggested that the students' increased awareness, understanding, and use of the text structure had a positive effect on their science content knowledge. A qualitative approach also supported questions 1 and 2, as I interpreted the results through a review of the student work samples, assessments, and teacher-created artifacts. In addition, qualitative research methods allowed me to recognize and describe the changes that occurred in my thinking as I integrated this literacy program into my science instruction (question 3). Conducting this research has led me, as a teacher, to become more refined and has given me a greater desire to help my students succeed.

CHAPTER 5

DISCUSSION

The purpose of this study was to examine the effectiveness of an instructional program that was designed to explicitly teach text structure awareness to fourth grade students as a tool to assist them in their understanding of science content in a unit of study on weather. An additional purpose of this study was to investigate the changes that occurred in my thinking and practice as a teacher throughout the process of developing and implementing this integrated instructional program into my science instruction. What follows in this chapter is a discussion of the conclusions and implications of the results of this research and recommendations for further research.

Conclusions

The findings from this study contribute to two bodies of educational literature: (a) that which emphasizes the development of scientifically literate individuals; and (b) that which attends to the key factors and issues related to improving the quality of science education through integrating science and literacy. As discussed in the literature, the most current reform movement in science education focuses on *all* children with an overarching goal to develop a scientifically literate population (AAAS, 1990, 1995; NRC, 1996; Southerland, Smith, Sowell, & Kittleson, 2007). Researchers (Norris & Phillips, 2003; Osborne & Wittrock, 1983) have stated that understanding science concepts and communicating about science requires the use of language, and that exploring the connections between science and literacy may enable educators to improve the overall quality of science education.

Through an integrated science-literacy instructional program, this study has allowed me as an educator to realize that teaching students to comprehend the language of science is critical to meeting the goal of scientific literacy. The statistical results of the pre and posttest analysis showed that the treatment group scored significantly higher on the content and text structure posttests than the students in the control group. These results suggest that the students in the treatment group increased in awareness, understanding, and use of the text structure, and that this integrated program had a positive impact on their science content knowledge.

Scientific literacy, as stated by Norris and Phillips (2003), entails communicating and knowing science in both a "fundamental" and "derived" sense. Through an analysis of the student work samples and assessments in this study, I was able to see that the scientific literacy of those that were exposed to the text structure awareness instruction was impacted in a positive way—both in the fundamental sense (their ability to communicate about science ideas or concepts), and in the derived sense (their understanding of scientific concepts). It was evident in their work that the depth of conceptual understanding and the ability to describe scientific knowledge differed by group.

One of the goals for this study was to explore students' ability to learn and transfer what they had learned about text structure to aid them in learning new science content. During the third step of the instructional program—where the text structure instruction was imbedded in their current science curriculum, I noted many instances of success where I was able to see that students had not only learned to use the text structure on their own, but it had positively affected their ability to learn and remember new

science content. What the students had been taught about text structure had not only influenced their ability to remember new science content, but also to articulate what they had learned about science in ways that made sense.

Through the process of actively reflecting upon my practice in this instructional study, I have learned that a reflective teacher wants to develop—that positive change comes about through experiences and reflection upon those experiences, and that any reflective teacher that desires positive change in the classroom will want to develop and change in order to become a better teacher. I have loved the learning and the changes that have taken place in my thinking as a teacher throughout the development and implementation of this integrated science and literacy unit. I have sought new challenges and taken risks. The lesson preparation at the outset of the study really had a positive effect on me—for my hard work in preparing well thought-out lessons made my instruction as a teacher better and more refined. While a few of the lessons I felt were full of "fluff," meaning I wished that I had dug deeper into science content and text structure—therefore allowing my students to have a better science learning experience overall, this reflection allowed me to see the importance of using the results of this research to guide my future instruction as a teacher. I have learned to appreciate that the outcome of my research was worthwhile (Bullough & Baughman, 1997; Smith, 2002). At the beginning of the research, I had written, "No matter what the results are in the end, I have become a more reflective, effective teacher, just by trying something new" (Reflective Journal, 08/2007). I feel that I truly have become a better teacher, "one [who] uses research and results to guide my instruction and to help my students succeed" (Reflective Journal, 09/26/07).

Implications

The findings from this study, along with other research that has been conducted, suggest that teaching students strategies to derive more meaning from text, such as text structure awareness and how to apply these specific strategic cognitive processes, may help to improve students' overall comprehension of informational text (Alvermann et al., 2004; Lemke, 2004; Moss, 2005; Ogle & Blanchowicz, 2002; Williams et al., 2005). In addition, teaching students about text structure awareness in a discipline-specific subject such as science has the potential to increase students' content knowledge and improve their scientific literacy (Moss, 2005; Norris & Phillips, 2003; Obsborne & Wittrock, 1983). The results of this particular study suggest that the students' increased awareness, understanding, and use of the text structure may have had a positive impact on their science content knowledge. Additionally, through the successes that I observed with the students, as well as changes in my own teaching beliefs as a result of this integrated science and literacy unit, I gained confidence that what I had taught my students actually worked. Moreover, through my experiences while implementing this program and my reflections on those experiences, my eyes were opened to the importance of enacting positive change in the classroom.

If our goal, as a nation, is for every student to attain scientific literacy, then it is necessary for teachers to understand how to teach all students and how to develop the professional skills and beliefs required to facilitate this vision of science literacy for all (Southerland et al., 2007). Through participating in effective pre-service and in-service education centered on successful teaching strategies, such as those that promote text structure awareness, teachers can gain access to new instructional methods that are aimed

at helping them to improve their instruction and enact positive changes in their classrooms (Hargreaves, 1994; Laplante, 1997; Lemke, 1997; Pajares, 1992; Richardson, 1996; Richardson, Anders, Tidwell, & Lloyd, 1991; Smith, 2002). As previously mentioned, change is central to education (Smith, 2002), and, as was my experience conducting this research, real change can come about as teachers experiment, implement, reflect, and think differently about their teaching.

Recommendations for Future Research

The results of this study suggest that teaching students to be aware of text structure may help improve their overall understanding of science content. Further research, including that which examines students' practice with the other conventional expository text structures during science instruction or instruction within other content areas is suggested.

In addition, this research suggests that other questions and ideas for further science and literacy research can emerge as teachers engage in reflective journaling. For example, through journaling and reflecting on my teaching during the study I repeatedly made remarks about how I felt I was not allowing my students to have rich enough science learning experiences where classroom-based science inquiry could have taken place. Even though inquiry was not an original focus of the study, it became something that I felt could have added to the effectiveness of the instructional unit. Thus, further research involving classroom-based science inquiry and literacy integration may lead to a better understanding of how integrated instructional units might enhance the development of scientific literacy. And finally, this study suggests that reflective teaching through

journaling may also be a way for teachers to enact positive change in the classroom and allow for better student learning experiences overall.

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APPENDIXES

APPENDIX A

Assessment Instrument: Pretest

Name_____

Weather Pretest

True *or* False

Circle the answer you think is correct.

1. True or False — Weather cannot be measured.

2. True or False — A calm day with little wind usually means the next day will be calm too.

3. True or False — Rain turns to snow when the air temperature gets warmer.

4. True or False — Air is a substance that takes up space and can be measured.

5. True or False — One important goal of weather forecasting is to save property and lives.

Multiple Choice

Choose the answer that best fits each question.

6. Study the Utah County weather data chart below and answer the question.

	Monday	Tuesday	Wednesday	Thursday	Friday
Temperature	93 F	87 F	82 F	80 F	85 F
Air Pressure	30.8 in	30.2 in	29.5 in	28.9 in	30.1 in
Wind Speed	5 mph	15 mph	25 mph	10 mph	5 mph
Cloud Cover	Clear	Partly cloudy	Cloudy	Clear	Clear

The month of the year that is probably represented here is

a. November b. March
c. July d. January

7. In the chart of data below, _____ is being recorded.

Day 1	Day 2	Day 3	Day 4	Day 5
67 F	71 F	69 F	70 F	72 F

a. temperature b. humidity
c. air speed d. air pressure

8. The most probable weather data for Salt Lake City in August is ____.
    a. 95 F temperature, 1 mph wind speed, sunny
    b. 20 F temperature, 10 mph wind speed, snow
    c. 48 F temperature, 50 mph wind speed, rain
    d. 65 F temperature, 15 mph wind speed, rain

9. Uncle Rob says that when cats sleep all day, it will rain the next day. This forecast is different than a meteorologist's because _____.
    a. he doesn't care what happens on Monday
    b. he isn't interested in accuracy
    c. he is not using scientific evidence or tools
    d. he is probably correct most of the time

10. Which of the following is the most scientific way to predict the weather?
    a. observe animal behavior
    b. observe changes in barometric pressure
    c. interview a person with achy joints
    d. count ice rings around the moon

11. The weather forecaster says that a thunderstorm is approaching your town. What kind of weather is coming?
    a. cirrus clouds, lower temperatures, and rain
    b. cirrus clouds, higher temperatures, and rain or snow
    c. stratus clouds, no temperature change, and no rain
    d. dark cumulus clouds, low temperatures, and rain

Fill in the blank

Choose from below the answers that fit in each blank

rain gauge air thermometer meteorologist barometer weather

12. Temperature is measured by using a _____.

13. A _____ is a scientist that studies weather.

14. An instrument that is used to measure air pressure is called a _____.

15. Temperature, humidity, and wind speed are all measurements of _____.

16. Precipitation can be measured by using a _____.

*Questions taken and adapted from the Utah County Utips website for educators: www.uctips.org

Name_____

Types of Clouds

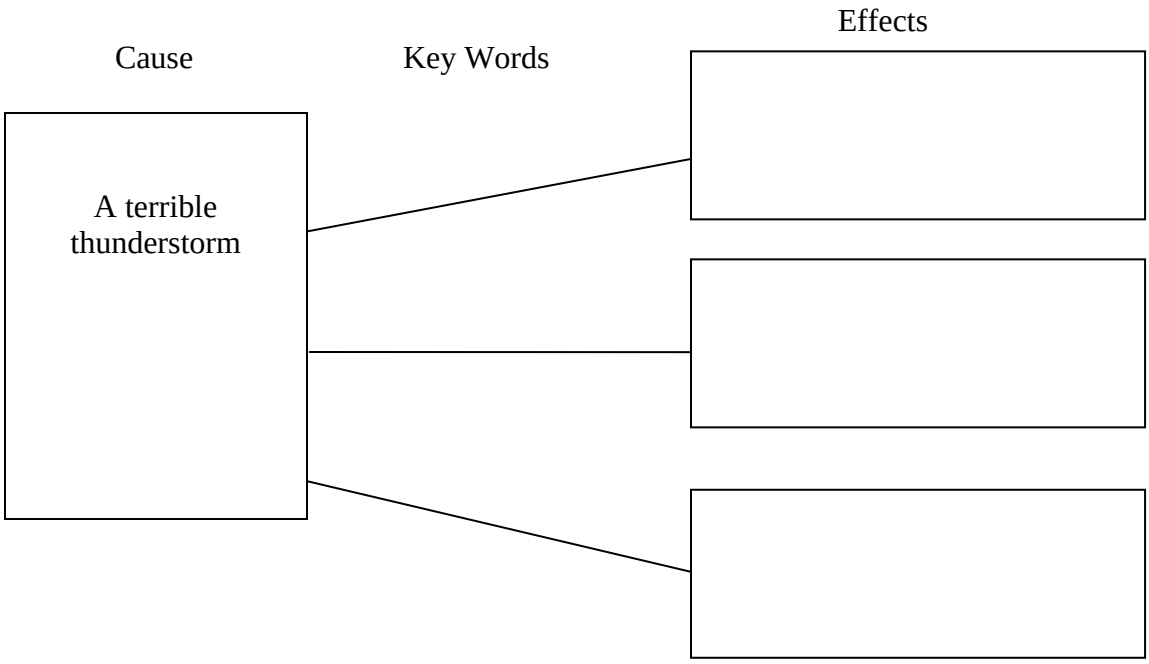
Draw a picture and describe what you know about each type of cloud:

Draw a picture		Describe what you know
Cirrus Clouds	17.	18.
Cumulus Clouds	19.	20.
Stratus Clouds	21.	22.

Name_____

Weather Pretest-Part 2

1. Complete the chart about the cause and effects of a terrible thunderstorm.



Using the information in the chart, write a cause/effect paragraph about a thunderstorm. Be sure to check for key words and accurate information.

_____

_____

_____

_____

_____

_____

2. Determine the cause and the effect(s) of this sentence.

A hurricane strikes your town, and as a result, it severely damaged property and caused flooding.

Cause:_____

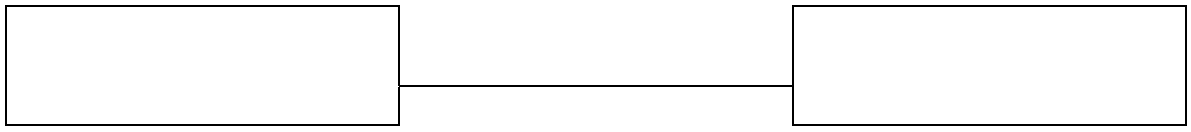
_____

Effect(s):_____

_____

Underline the key word in the sentence, and then map it out below.

3. When water vapor turns directly to ice, then it snows.



Writing cause *and* effect sentences

4. Write a cause/effect sentence about the wind. Underline the key word.

_____

_____

_____

_____

5. While reading a thermometer, you notice that the temperature has fallen throughout the day. What might be the <u>cause</u> of this? Write a cause and effect sentence. Underline your key word.

_____

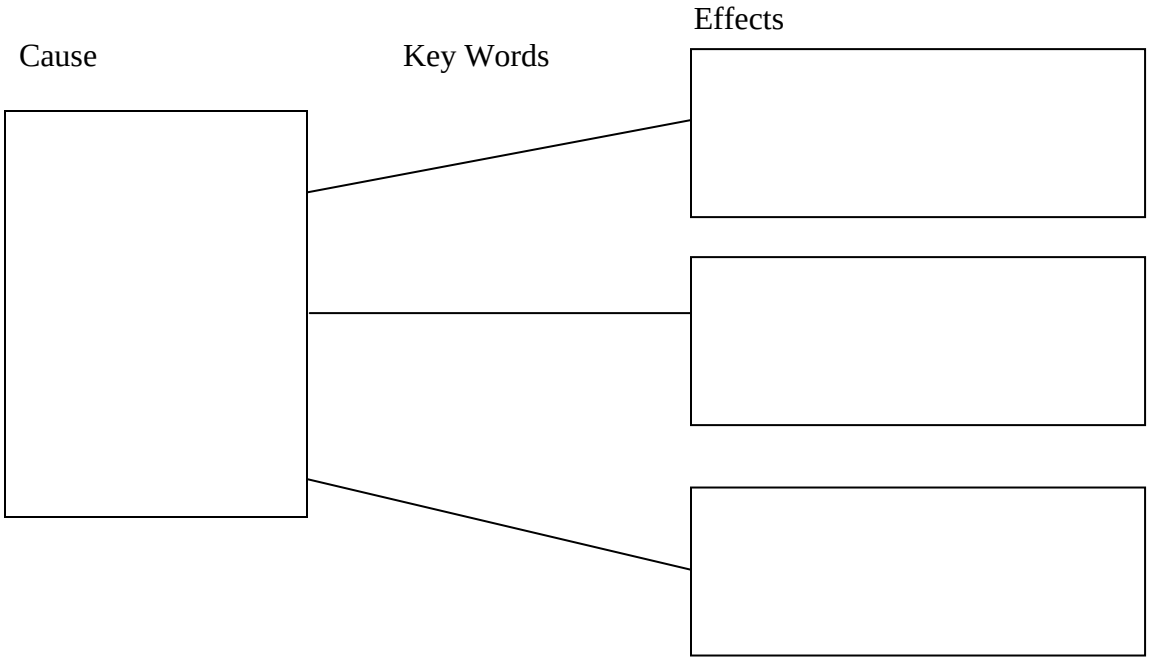
_____

_____

_____

6. Read the paragraph and then map it out below.

A class of fourth grade students in West Jordan, Utah went outdoors to observe the weather for an experiment they were doing in Science. The air temperature was 70˚ F (21˚ Celsius) under very windy conditions. Looking to the west, the students noticed very dark clouds. The students recorded their observations in their science notebooks. An hour later, the students were shocked to hear from their teacher that a tornado had struck downtown Salt Lake City. As a result of the tornado, many trees were uprooted, buildings had collapsed, and because of this, many people were injured.



7. List 6 key words you might find while reading a cause/effect text.

1._____ 2._____ 3._____

4._____ 5._____ 6._____

KEY

Weather Pretest

True *or* False

Circle the answer you think is correct.

1. True or FALSE — Weather cannot be measured.

2. TRUE or False — A calm day with little wind usually means the next day will be calm too.

3. True or FALSE — Rain turns to snow when the air temperature gets warmer.

4. TRUE or False — Air is a substance that takes up space and can be measured.

5. TRUE or False — One important goal of weather forecasting is to save property and lives.

Multiple Choice

Choose the answer that best fits each question.

6. Study the Utah County weather data chart below and answer the question.

	Monday	Tuesday	Wednesday	Thursday	Friday
Temperature	93 F	87 F	82 F	80 F	85 F
Air Pressure	30.8 in	30.2 in	29.5 in	28.9 in	30.1 in
Wind Speed	5 mph	15 mph	25 mph	10 mph	5 mph
Cloud Cover	Clear	Partly cloudy	Cloudy	Clear	Clear

The month of the year that is probably represented here is

a. November
b. March
c. JULY
d. January

7. In the chart of data below, _____ is being recorded.

Day 1	Day 2	Day 3	Day 4	Day 5
67 F	71 F	69 F	70 F	72 F

a. TEMPERATURE
b. humidity
c. air speed
d. air pressure

8. The most probable weather data for Salt Lake City in August is ____.

a. 95 F TEMPERATURE, 1 MPH WIND SPEED, SUNNY
b. 20 F temperature, 10 mph wind speed, snow
c. 48 F temperature, 50 mph wind speed, rain
d. 65 F temperature, 15 mph wind speed, rain

9. Uncle Rob says that when cats sleep all day, it will rain the next day. This forecast is different than a meteorologist's because _____.

   a. he doesn't care what happens on Monday
   b. he isn't interested in accuracy
   c. HE IS NOT USING SCIENTIFIC EVIDENCE OR TOOLS
   d. he is probably correct most of the time

10. Which of the following is the most scientific way to predict the weather?
   a. observe animal behavior
   b. OBSERVE CHANGES IN BAROMETRIC PRESSURE
   c. interview a person with achy joints
   d. count ice rings around the moon

11. The weather forecaster says that a thunderstorm is approaching your town. What kind of weather is coming?
   a. cirrus clouds, lower temperatures, and rain
   b. cirrus clouds, higher temperatures, and rain or snow
   c. stratus clouds, no temperature change, and no rain
   d. DARK CUMULUS CLOUDS, LOW TEMPERATURE, AND RAIN

Fill in the blank

Choose from below the answers that fit in each blank

rain gauge air thermometer meteorologist barometer weather

12. Temperature is measured by using a THERMOMETER.

13. A METEOROLOGIST is a scientist that studies weather.

14. An instrument that is used to measure air pressure is called a BAROMETER.

15. Temperature, humidity, and wind speed are all measurements of WEATHER.

16. Precipitation can be measured by using a RAIN GAUGE.

*Questions taken and adapted from the Utah County Utips website for educators: www.uctips.org

KEY

Types of Clouds

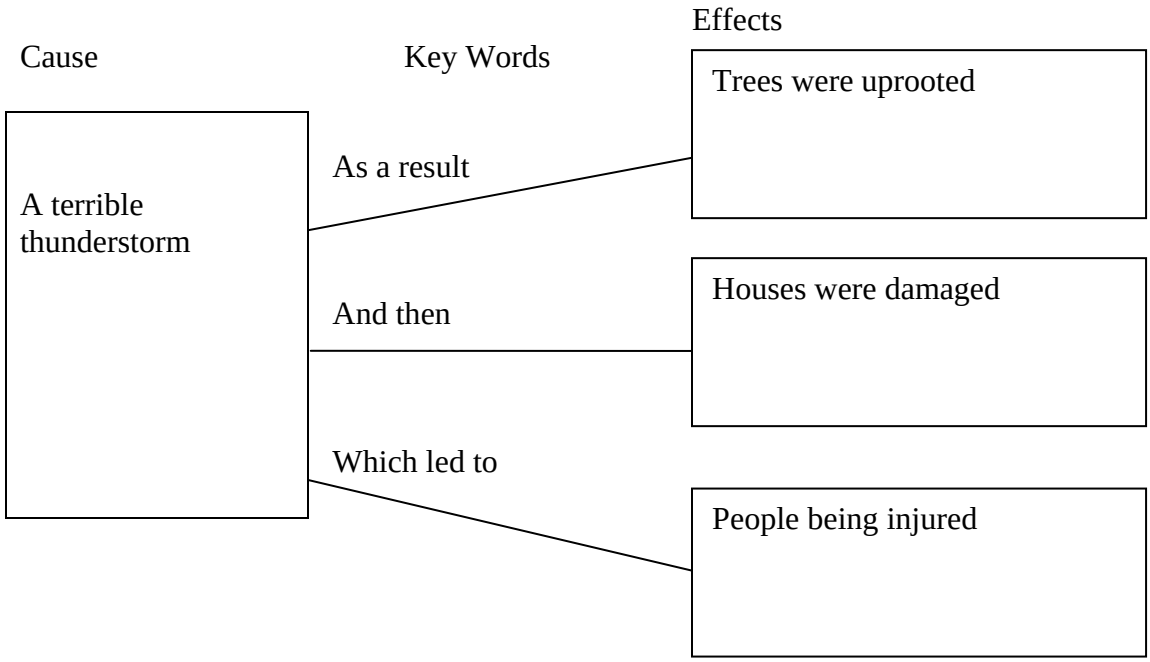
Draw a picture and describe what you know about each type of cloud:

	Draw a picture	Describe what you know
Cirrus Clouds	16.	17. Cirrus clouds are high, thin wispy clouds. Usually indicate cool, fair weather. These clouds could mean a warm front is approaching and the weather will turn stormy in a day or two.
Cumulus Clouds	18.	19. Cumulus clouds are the big, puffy, white clouds. They are the kind you like to watch on a pleasant summer day. Cumulus clouds usually mean fair, clear, warm weather.
Stratus Clouds	20.	21. Stratus clouds are lower and occur along warm fronts. They are usually gray and often fill the sky completely. These “blanket” clouds could indicate rain or snow.

KEY

Weather Pretest-Text Structure

1. Complete the chart about the cause and effects of a terrible thunderstorm.



Using the information in the chart, write a cause/effect paragraph about a thunderstorm. Be sure to check for key words and accurate information.

Ex.) A terrible thunderstorm hit our city. As a result, trees were uprooted, and then houses were damaged, which led to people being injured.

2. Determine the cause and the effect(s) of this sentence.

A hurricane strikes your town, and as a result, it severely damaged property and caused flooding.

Cause: A hurricane strikes your town.

Effect(s): It severely damaged property and caused flooding.

3. When water vapor turns directly to ice, then it snows.

When water vapor turns directly to ice	then	it snows

Writing cause *and* effect sentences (answers will vary)

4. Write a cause/effect sentence about the wind (remember that wind can cause relief or disaster). Underline your key word.

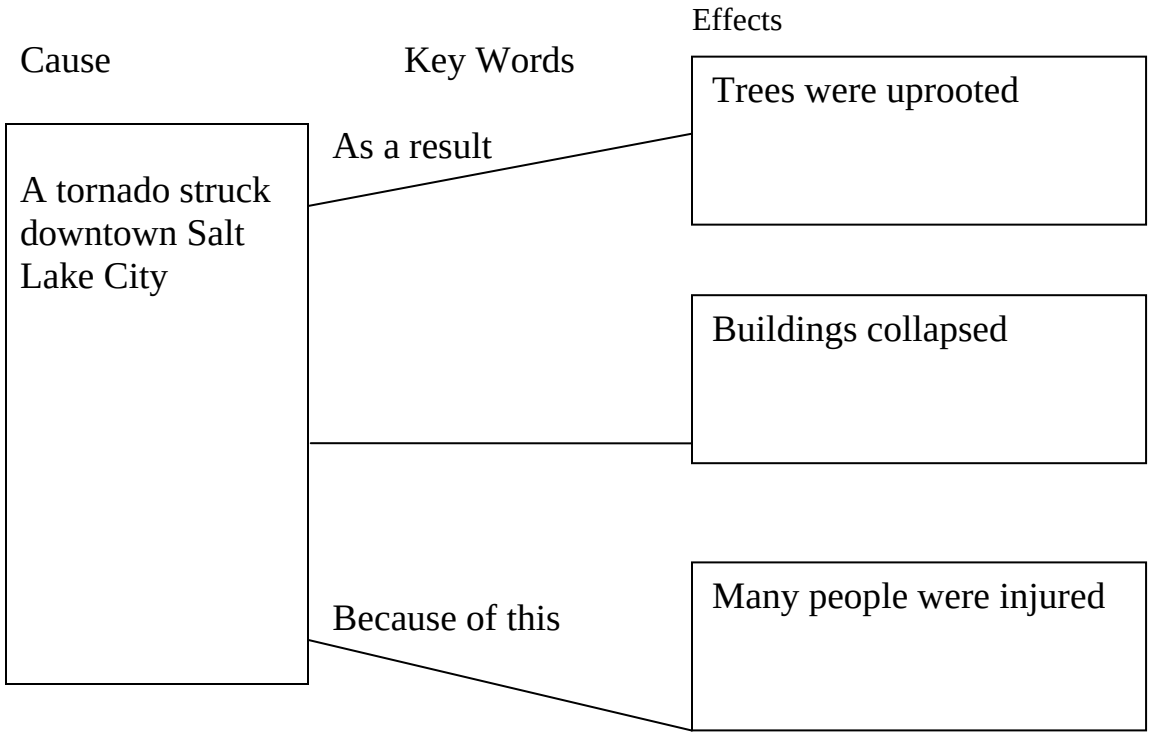
If there is too strong of a wind, then people can get hurt and property can be damaged.

5. While reading a thermometer, you notice that the temperature has fallen throughout the day. What might be the <u>cause</u> of this? Write a cause and effect sentence. Underline your key word.

The temperature on a thermometer falling <u>is a result of</u> a cold front coming in.

6. Read the paragraph and then map it out below.

A class of fourth grade students in West Jordan, Utah went outdoors to observe the weather for an experiment they were doing in Science. The air temperature was 70˚ F (21˚ Celsius) under very windy conditions. Looking to the west, the students noticed very dark clouds. The students recorded their observations in their science notebooks. An hour later, the students were shocked to hear from their teacher that a tornado had struck downtown Salt Lake City. As a result of the tornado, many trees were uprooted, buildings had collapsed, and because of this, many people were injured.



7. List 6 key words you might find while reading a cause/effect text.

because	this led to	as a result
then	since	and so
reason for	explains why	result
caused	if…then	

APPENDIX B

TEXT STRUCTURE LESSONS: STEP 1 AND 2

Text Structure

Three-step strategy approach

Step 1 & 2 lessons

Karen Thomas

4th Grade

Step 1: Direct Instruction in the text structure

Lesson 1: Introduce text Structure

Literacy Objectives:

Standard VIII: Writing
Objective 1d: Use a variety of graphic organizers to organize information
Objective 6c: Produce informational text (e.g., book reports, Compare/contrast essays, cause/effect reports, observational reports, research reports, content area reports, biographies, summaries).

Materials:

Cause/effect key word poster
Cause/effect handout (one copy per 3 students)

Purpose:

The purpose of this lesson is to familiarize students with text structure, specifically, the cause/effect structure. Students will be taught the cause/effect text structure conceptually, and will be able to create single cause/effect sentences using the structure.

Lesson:

Show students a Science/Social studies textbook and begin by introducing students to the concept of text structure and how the structure of the text reflects the author's ideas and the relationships of those ideas to one another. Explain how, by learning to identify and use the structure of the texts, they will able to read and study more quickly and effectively and understand and recall the information in the text better.

Tell students that there are many types of different text structures that the author uses when writing informational books (like Science and Social Studies), one of which is called 'cause/effect'. Write the words 'cause/effect' on the board. Ask students to tell what they think the meanings of these words are. It may be helpful to explain cause and effects like this:

1. If you want to determine the cause of something, ask yourself "why". Use a word like "because" to determine the effect.
    a. Ex. *Why* do we wear coats on a cold winter day? *Because* it is cold!
2. One thing leads to another (the "one thing" is the cause which leads to "another" or the effect)
    a. Ex. If I don't wear my coat on a cold winter day, then I will be cold!

After defining cause and effect, introduce the key words poster. Tell the students that key words are what authors use to make it easier to follow along in the text and remember what you read.

Key Words-cause/effect

because	this led to	as a result
then	since	and so
reason for	explains why	result
caused	if…then	

Give a few examples (orally) of cause/effect sentences while directing the students attention to the key words poster. Using real-life simple examples will be easier for them to understand. Here are some examples that you could use:

Cause	Effect
Fall off your bike	Get hurt
Eat too much candy	Get sick
Play in the sun without sunscreen	Get sunburned
Practice shooting hoops	Get better at basketball
Clean the house	Mom will be happy

Write the cause/effect sentence on the board, and then map out the sentence (like the handout).

Ex. I fell off my bike, and so I got hurt.

I fell off my bike	and so Key Word	I got hurt
Cause		Effect

Invite the class members to share some other examples of a cause/effect sentence. After creating a few as a class, have the students turn to their neighbors to orally create some on their own. Remind the students to use **KEY WORDS** in their sentences.

Assessment:

After the students have shown that they can successfully create cause/effect sentences using the key words, arrange the students into groups of three. Give each group a cause/effect handout, and have the students write a cause/effect sentence and map out their sentence using the key word.

When all of the groups have finished creating a cause/effect sentence, have group members share their sentence with the class. With the first group, write the sentence on the board and then map it out (like the handout). With the next group, write out the sentence, but ask another student (that is not in the group) to map out the sentence-identifying the cause/effect and the key word

Names of group members _____ _____ _____

Cause/Effect

As a group write a cause/effect sentence. Circle the key word that you use.

Cause/effect sentence:

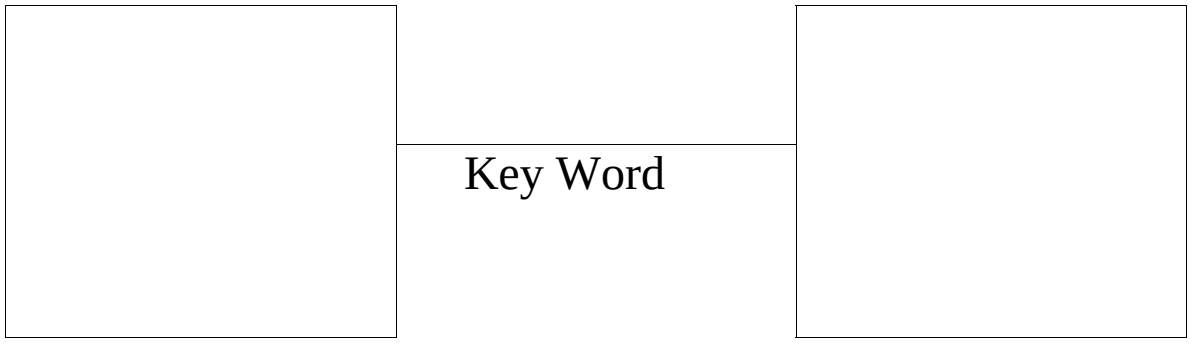
_____

_____

_____

_____

Now map out your cause/effect sentence. Put the cause in the first box and the effect in the second box.Write the key word on the line in the middle.



Cause Effect

KEY (Example)

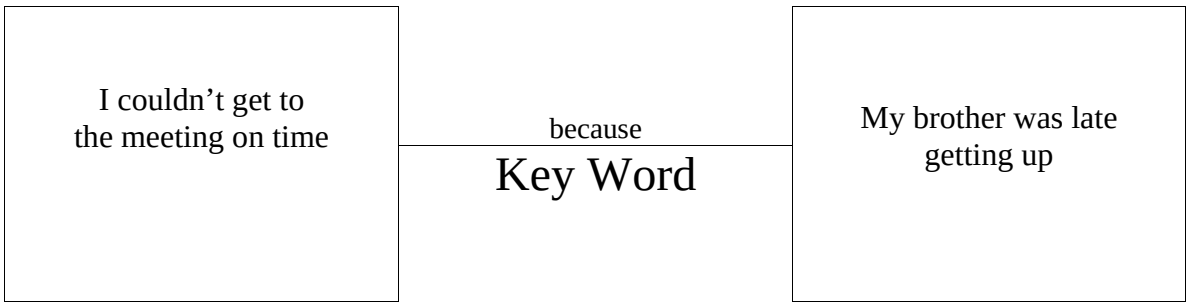
Cause/Effect

As a group write a cause/effect sentence. Circle the key word that you use.

Cause/effect sentence:

I couldn’t get to the meeting on time because my little brother was late getting up.

Now map out your cause/effect sentence. Put the cause in the first box and the effect in the second box. Write the key word on the line in the middle.



Cause Effect

Key Words
Cause/Effect

because	since
then	explains why
reason for	if…then
caused	as a result
this led to	and so

Lesson 2: Practice with text structure: Key words

Literacy Objectives:

Standard VIII: Writing
Objective 1d: Use a variety of graphic organizers to organize information
Objective 6c: Produce informational text (e.g., book reports, compare/contrast essays, observational reports, research reports, content area reports, biographies, summaries).

Materials

Cause/effect key word poster
Cause/effect paragraphs (one copy per 3 students)
Cause/effect key word handout

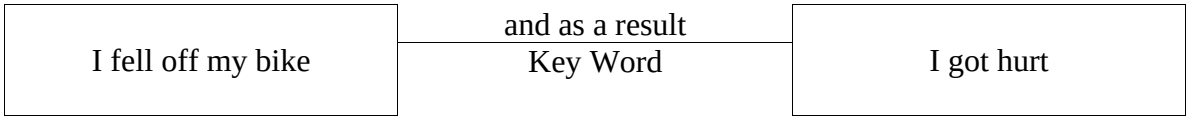
Purpose:

The purpose of this lesson is to allow students the opportunity to locate key words in cause/effect sentences with multiple effects.

Lesson:

Review with the students what a cause/effect sentence is. Generate a few sentences and maps on the board with the students (as in the previous lesson).

Ex. I fell off my bike, and as a result I got hurt.

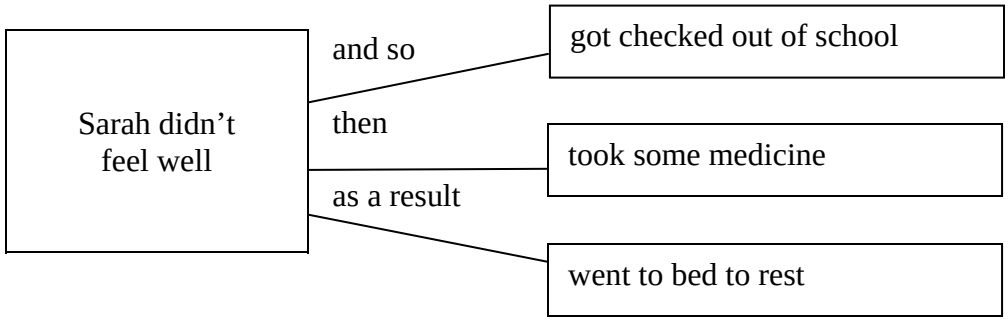


Cause Effect

Tell students that there are times when you can have a cause with many different effects. In other words, you can have something happen that causes a lot of different things. Illustrate the following example:

> Sarah didn't feel very well, and so she got checked out of school, then she took some medicine, and as a result, went to bed to rest.

Map out the cause/effect sentence with the students, showing the cause (Sarah didn't feel well) along with the three effects. Ask students what other types of key words they could use in this cause/effect sentence and record them on the map.



Have students turn to their neighbors and practice making a sentence with one cause and many effects. Then share as a class a few of the examples.

Now give students the chance to locate key words in cause/effect sentences. Arrange the students in groups of three and give them the sentences to practice with. Point out that some sentences will have more than one key word. Remind students to look at the key word poster if they need help. Have them read the sentences and then circle the key words.

Once students are finished locating the key words, have the groups read their paragraphs to the class. Call on volunteers from the class to state what the key words were in each paragraph. Collect the papers, as you will use them in the next lesson.

Assessment:

Give the handout to the students and tell them that they are going to now practice on their own locating the key words. Put the key word poster away so that students can try to find the words from memory.

Cause/Effect

As a group, read the sentences and discuss what the key word is. Circle the key word. Be careful--some of the paragraphs have more than one key word.

1. Jeffrey fell down; as a result he scraped his knee, started crying, and called for help.

2. Jamie decided to play on a summer softball team and so she needed to find a mitt, dig out her old cleats, and then start practicing so that she could be a good player.

3. Josh accidentally threw a baseball through his neighbor's window. Because of this, his dad told him that he would have to pay for the window. This explains why Josh ended up spending the next two weeks mowing lawns to earn money.

4. Dad forgot to set the timer for the sprinklers when we went on our vacation to Disneyland. Since were we gone for two whole weeks, the grass burnt up, the flowers died, and as a result my mom was really mad!

KEY (Example)

Cause/Effect

As a group, read the sentences and discuss what the key word is. Circle the key word. Be careful--some of the paragraphs have more than one key word.

1. Jeffrey fell down; AS A RESULT he scraped his knee, started crying, and called for help.

2. Jamie decided to play on a summer softball team AND SO she needed to find a mitt, dig out her old cleats, and THEN start practicing so that she could be a good player.

3. Josh accidentally threw a baseball through his neighbor's window. BECAUSE of this, his dad told him that he would have to pay for the window. This EXPLAINS WHY Josh ended up spending the next two weeks mowing lawns to earn money.

4. Dad forgot to set the timer for the sprinklers when we went on our vacation to Disneyland. SINCE were we gone for two whole weeks, the grass burnt up, the flowers died, and AS A RESULT my mom was really mad!

Name: _____

Cause/Effect

In each example, locate the key word and circle it. Remember that some of the sentences may have more than one key word!

1. The power went out on our street because someone was digging in their yard and hit a power line. As a result, we didn't have any power, couldn't cook dinner, call our friends, or watch TV.

2. "If you drop the eggs then they will break!", my mom said as we were bringing the groceries in the house. I was trying really hard to walk carefully when I tripped on my brother's toy! This led to me falling, dropping the eggs, and caused the eggs to break!

Now list the key words you found in the sentences, and any other ones that you can think of in the box.

Key Words I know:

KEY (Example)

Cause/Effect

In each example, locate the key word and circle it. Remember that some of the sentences may have more than one key word!

1. The power went out on our street BECAUSE someone was digging in their yard and hit a power line. AS A RESULT, we didn't have any power, couldn't cook dinner, call our friends, or watch TV.

3. "If you drop the eggs then they will break!", my mom said as we were bringing the groceries in the house. I was trying really hard to walk carefully when I tripped on my brother's toy! THIS LED TO me falling, dropping the eggs, and CAUSED the eggs to break!

Now list the key words you found in the sentences, and any other ones that you can think of in the box.

Key Words I know:

BECAUSE, AS A RESULT,
THIS LED TO, CAUSED…

Lesson 3: Practice with text structure: Key words & mapping

Literacy Objectives:

Standard VIII: Writing
Objective 1d: Use a variety of graphic organizers to organize information
Objective 6c: Produce informational text (e.g., book reports, compare/contrast essays, observational reports, research reports, content area reports, biographies, summaries).

Materials

Cause/effect key word poster
Cause/effect paragraphs from lesson 2 (one copy per 3 students)
Cause/effect map handout

Purpose:

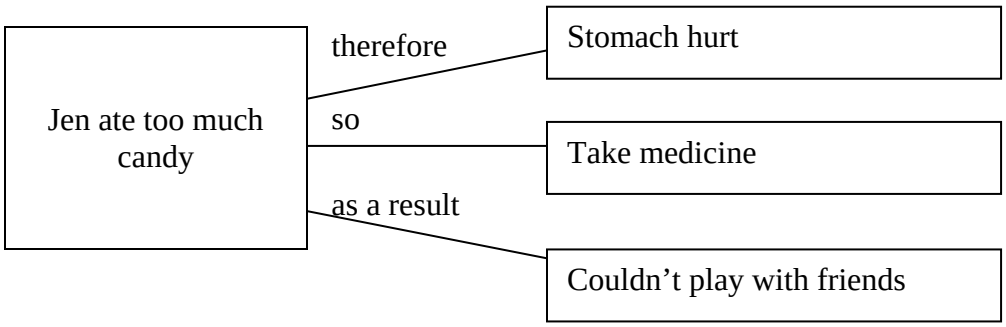
The purpose of this lesson is to allow students the opportunity to practice locating key words in cause/effect paragraphs and mapping out the sentences.

Lesson:

Review with the students a cause/effect sentence and cause that might have more than one effect (as in previous lesson). Have students point out the key words, and circle them.

Ex.) Jen ate too much candy, therefore her stomach hurt, and so she had to take some medicine and as a result she couldn't play with her friends.

Now map out the paragraph on the board with the students.



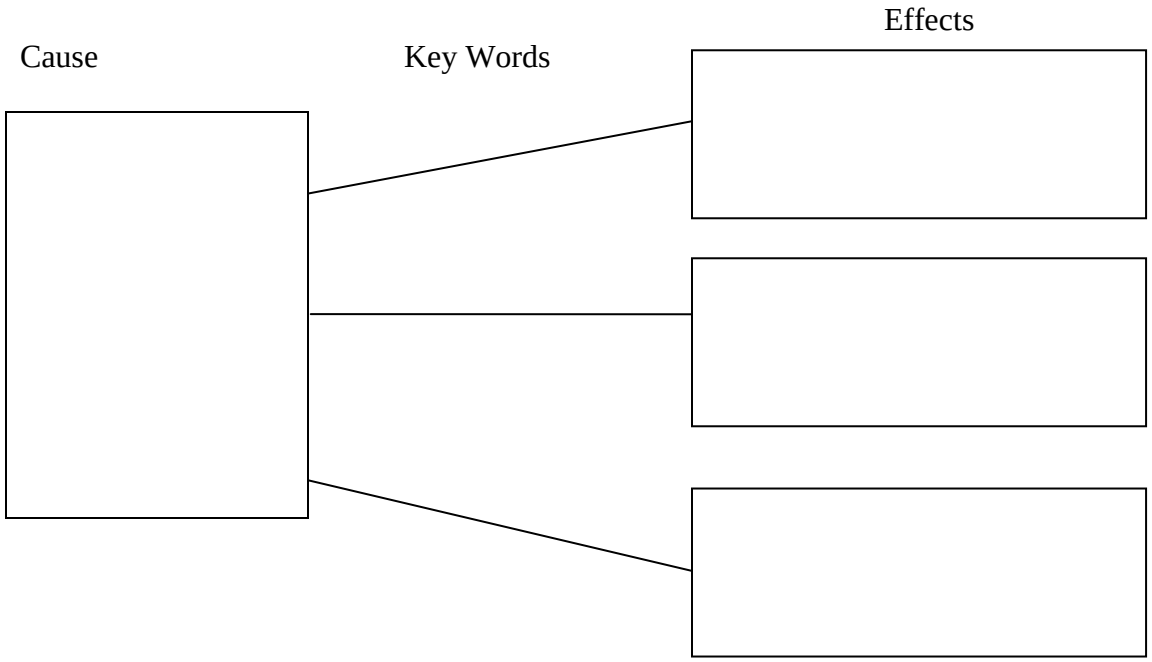
Have students get in the same group they were in-in the previous lesson. Pass out to each group, the cause/effect paragraphs that they worked on in lesson 2. Tell students that they will now make maps of the paragraphs that they worked on yesterday. They need to choose 2 paragraphs to map with their groups. Once students are finished mapping out the paragraphs, tell them that they now will have a chance to make up their own cause/effect paragraph with a partner and map it.

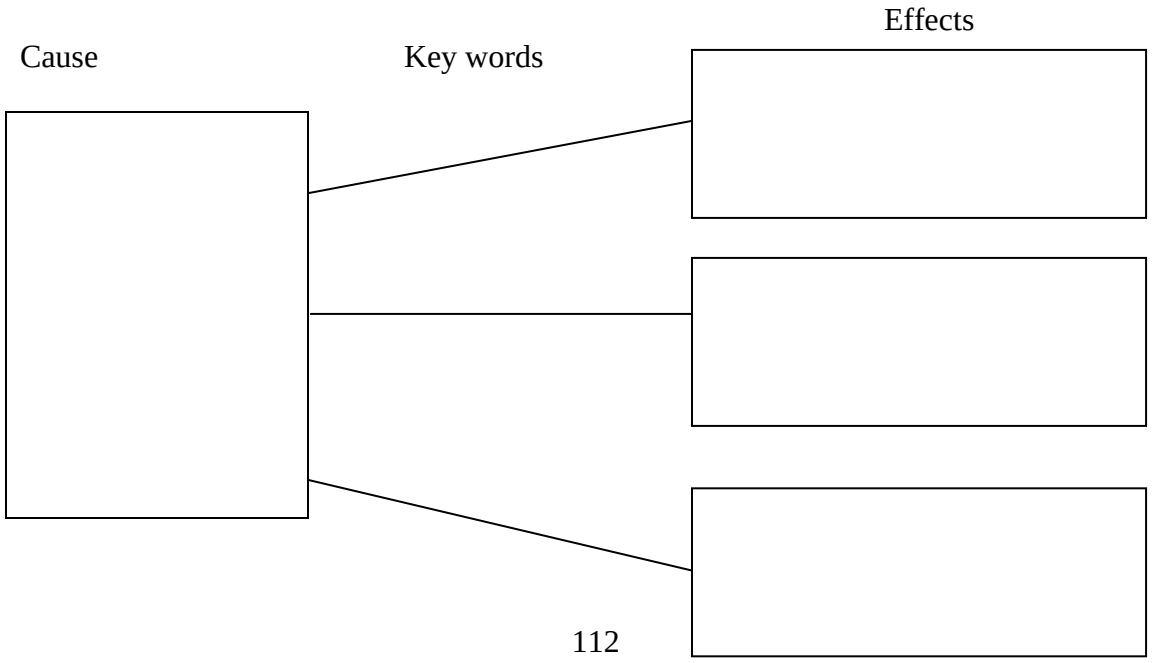
Assessment:

Let students choose a partner, and give them a blank cause/effect map to complete.

Cause/Effect Maps

With your group, choose 2 out of the 4 paragraphs to map. Write the cause in the left box, the key words on the middle lines, and the effects in the right boxes. Remember that some of the paragraphs have more than one key word and effect, but you may not need to use all of the key word lines or the effects boxes.

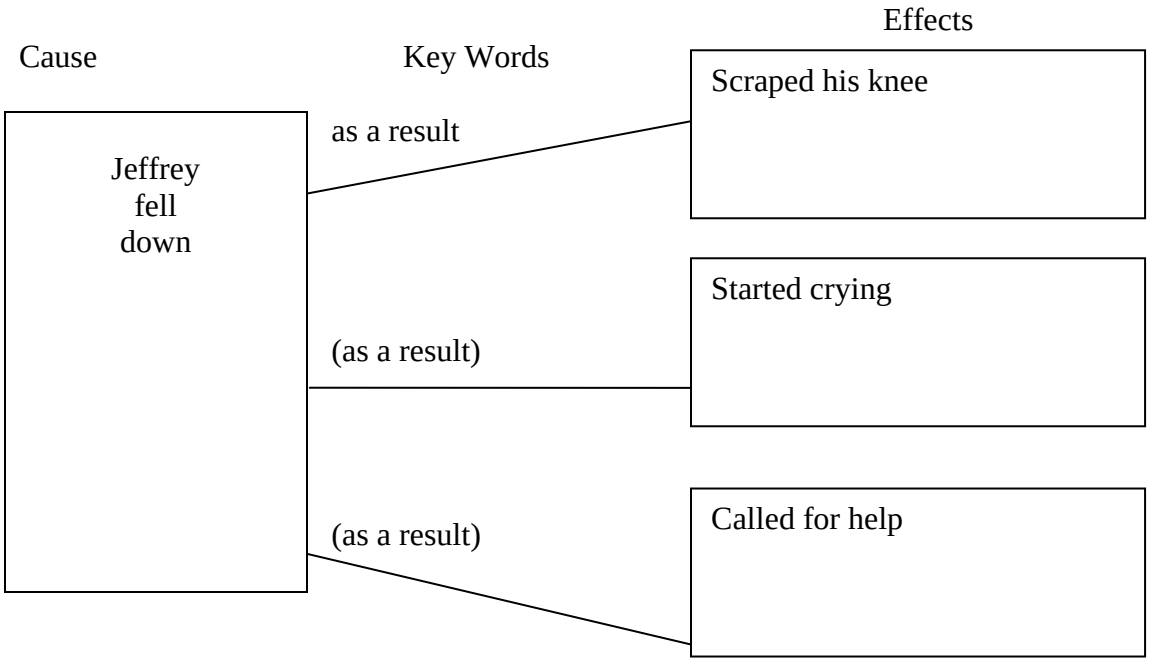


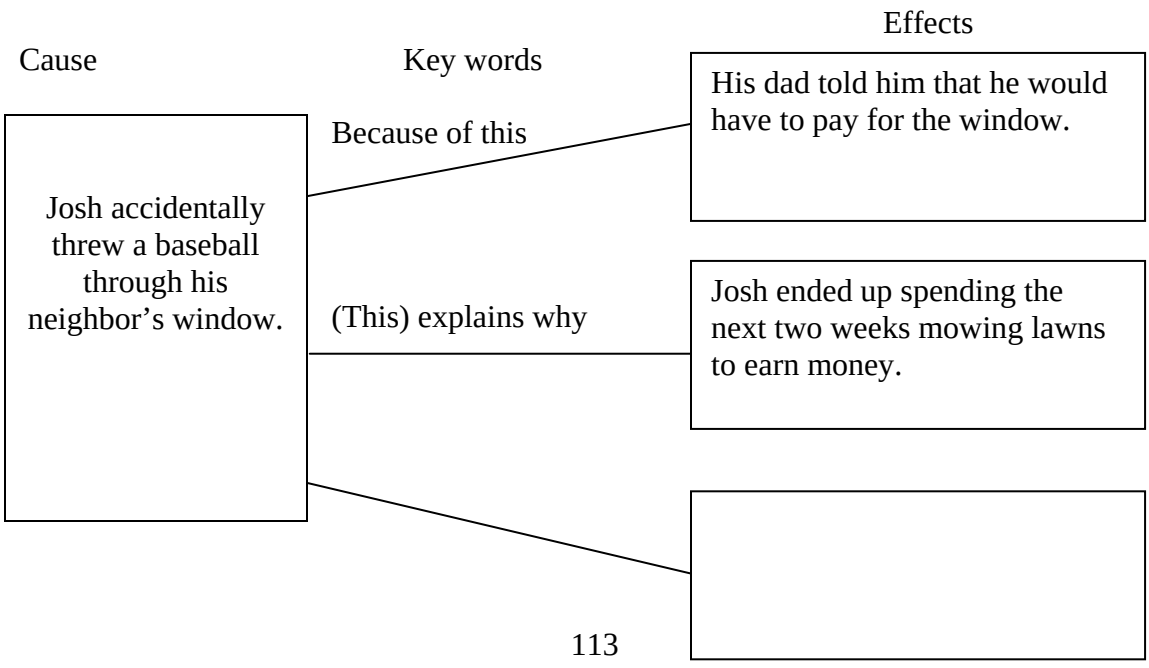


KEY (Example)

Cause/Effect Maps

With your group, choose 2 out of the 4 paragraphs to map. Write the cause in the left box, the key words on the middle lines, and the effects in the right boxes. Remember that some of the paragraphs have more than one key word and effect, but you may not need to use all of the key word lines or the effects boxes.



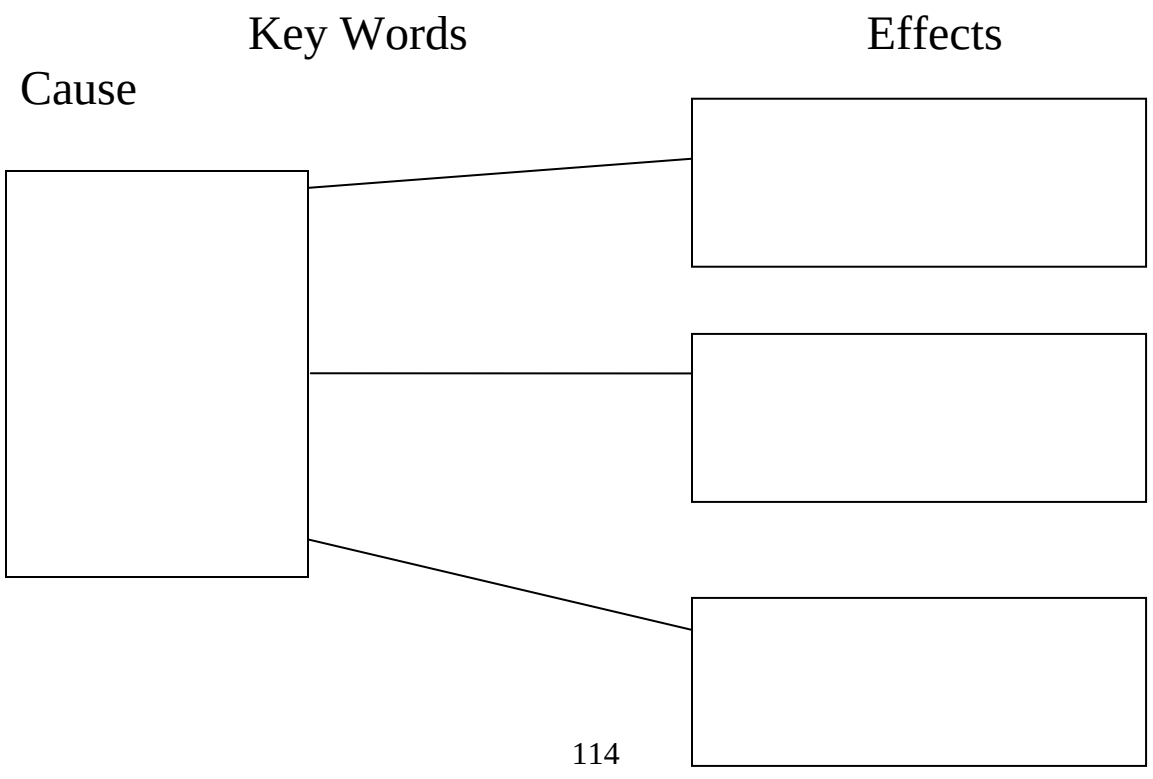


Names: _____ _____

Cause/effect paragraph & map

Together, create a cause/effect paragraph. Pay special attention to the key words that you use.

Now map out your paragraph using the map below.



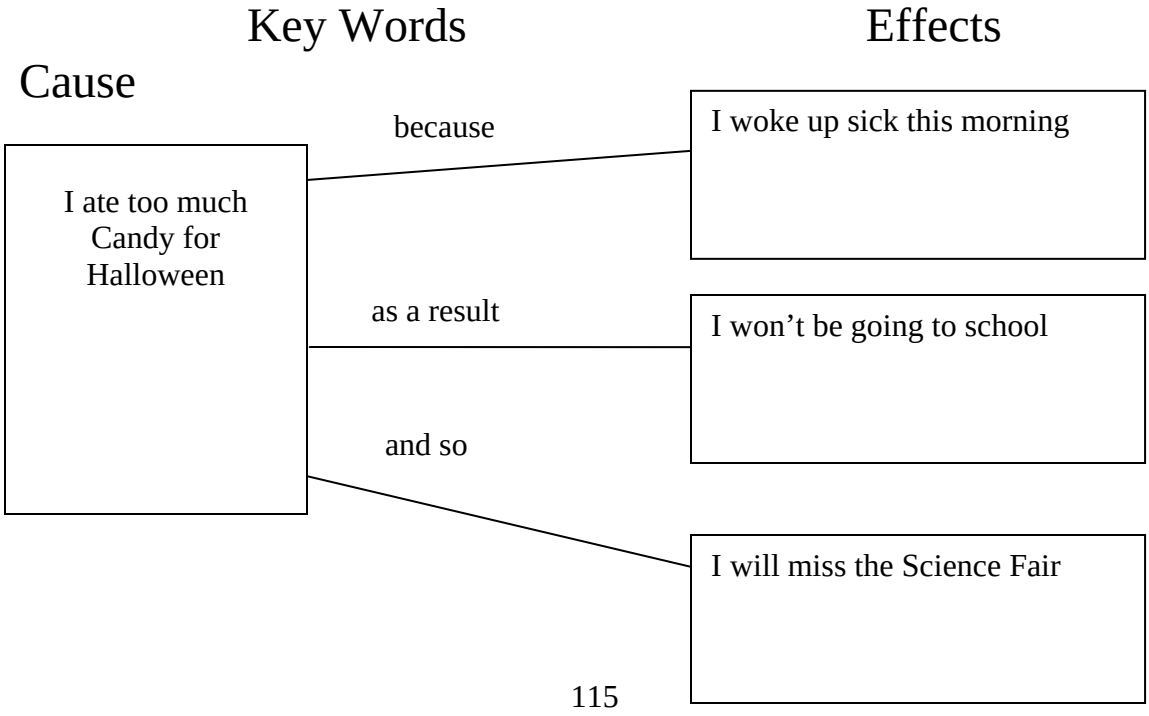
KEY (Example)

Cause/effect paragraph & map

Together, create a cause/effect paragraph. Pay special attention to the key words that you use.

Because I ate too much candy for Halloween, I woke up sick this morning. As a result, I won't be going to school and so I will have to miss the Science Fair today.

Now map out your paragraph using the map below.



Lesson 4: Practice with text structure: Key words, mapping, & summarizing

Literacy Objectives:

Standard VIII: Writing
Objective 1d: Use a variety of graphic organizers to organize information
Objective 6c: Produce informational text (e.g., book reports, compare/contrast essays, observational reports, research reports, content area reports, biographies, summaries).

Materials

Cause/effect key word poster
Cause/effect paragraphs (one copy per 3 students)
Overhead of "The Storm Is Coming"
"Fishing Boat" handout

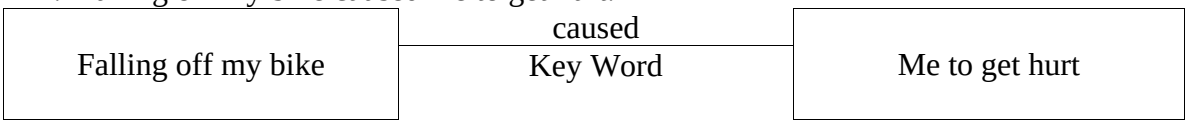
Purpose:

The purpose of this lesson is to allow students the opportunity to practice locating key words in cause/effect paragraphs, map out the sentences, and create a short summary using the key words.

Lesson:

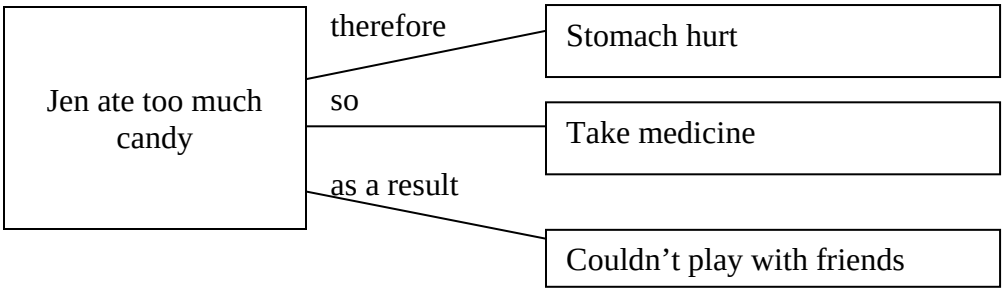
Remind students about the different types of cause/effect sentences that they worked on in the last 3 lessons. Have the students turn to their neighbors and together create a cause/effect sentence—either one cause/effect, or one cause with several effects. Call on a few of the students and map them out on the board as they tell them to you (as in previous lessons).

Ex. Falling off my bike caused me to get hurt.



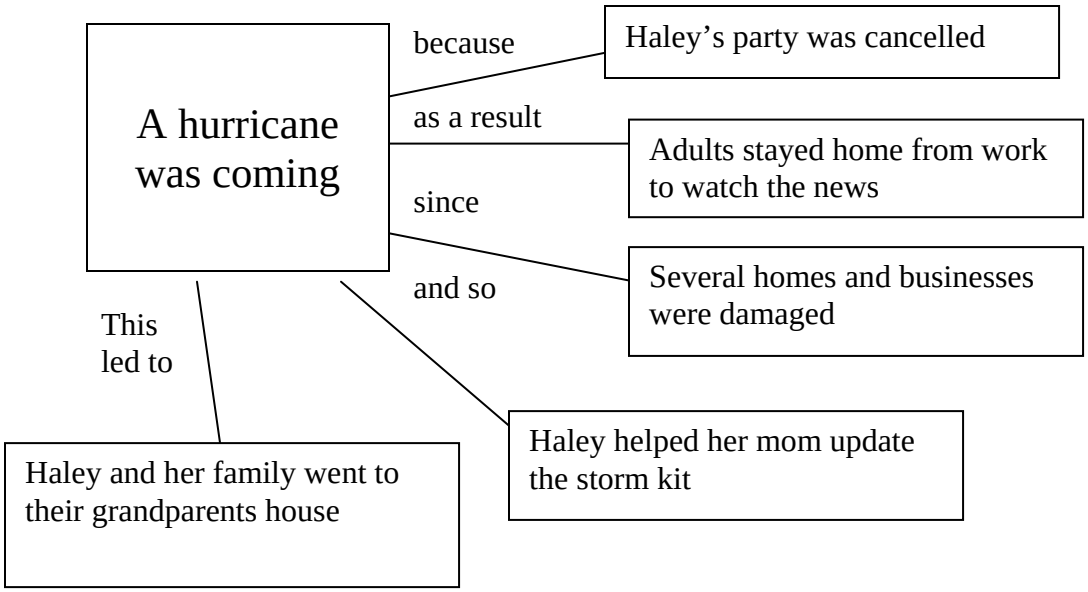
Cause Effect

Ex. Jen ate too much candy, therefore her stomach hurt, so she had to take medicine, and as a result, she couldn't play with her friends.



Tell students that often times when you read something, it is good to once in a while quickly summarize what you have red so far—this helps you to remember more of what you read.

Place the overhead up of the story "The Storm Is Coming" and read it aloud to the students. Call on volunteers to point out where the key words are, and circle them. Tell the students that since this is a longer story, we are going to summarize it using the just the main points with the key words. Start with the map. Ask students to help you fill in the map.



Now as a class, generate a summary from the map. Here is an example you might use. Remind the students that when they summarize, it is a good idea to add words in so that the sentences run smoothly.

A hurricane was coming, and because of this Haley's birthday party was cancelled. As a result of the hurricane, the adults stayed home from work to watch the news. Since the storm was approaching fast, several homes and businesses had already been damaged, and so Haley helped her mom update the storm kit to be ready for the storm. This all led to Haley and her family deciding to travel to Atlanta to stay with their grandparents so they would be safe from the storm.

Assessment:

Arrange the students in groups of three, and hand out the student cause/effect story "Fishing Boat" to each group. Now have them read the story and together circle the key words and complete a map and a summary. After the students are finished, have them share their summaries with the class.

**Save the "Fishing Boat" stories, as you will use them for examples in lesson 6.

The Storm Is Coming

Haley was so sad! She just couldn't believe it! She was supposed to have her birthday party tomorrow at the Super Kool Skateboard Park, but now there was a chance that the city was going to get hit by a huge storm called a hurricane! Because of this, the party was cancelled and would have to be rescheduled.

As a result of the storm warning, all the adults kept very close to their televisions and did not go to work so that they could see what the news was saying. The storm was quickly heading towards Miami, which is where Haley lived. The storm had winds up to 120 miles per hour! The news reported that since the storm had started, several homes and businesses had already been damaged. And so, instead of running around with her mom getting ready for her birthday party, Haley was busy helping her mom update their storm safety kit. They needed new batteries for the flashlights and radios, fresh water, a blanket, and some food.

The storm was approaching fast, and this led to Haley and her family deciding to take their storm safety kit and travel to Atlanta where her grandparents lived so that they could be safe from the storm. Hopefully they will be able to return home soon, but she is also excited that she will get to visit her grandparents!

The Storm Is Coming (key)

Haley was so sad! She just couldn't believe it! She was supposed to have her birthday party tomorrow at the Super Kool Skateboard Park, but now there was a chance that the city was going to get hit by a huge storm called a hurricane! BECAUSE of this, the party was cancelled and would have to be rescheduled.

AS A RESULT of the storm warning, all the adults kept very close to their televisions and did not go to work so that they could see what the news was saying. The storm was quickly heading towards Miami, which is where Haley lived. The storm had winds up to 120 miles per hour! The news reported that SINCE the storm had started, several homes and businesses had already been damaged. AND SO, instead of running around with her mom getting ready for her birthday party, Haley was busy helping her mom update their storm safety kit. They needed new batteries for the flashlights and radios, fresh water, a blanket, and some food.

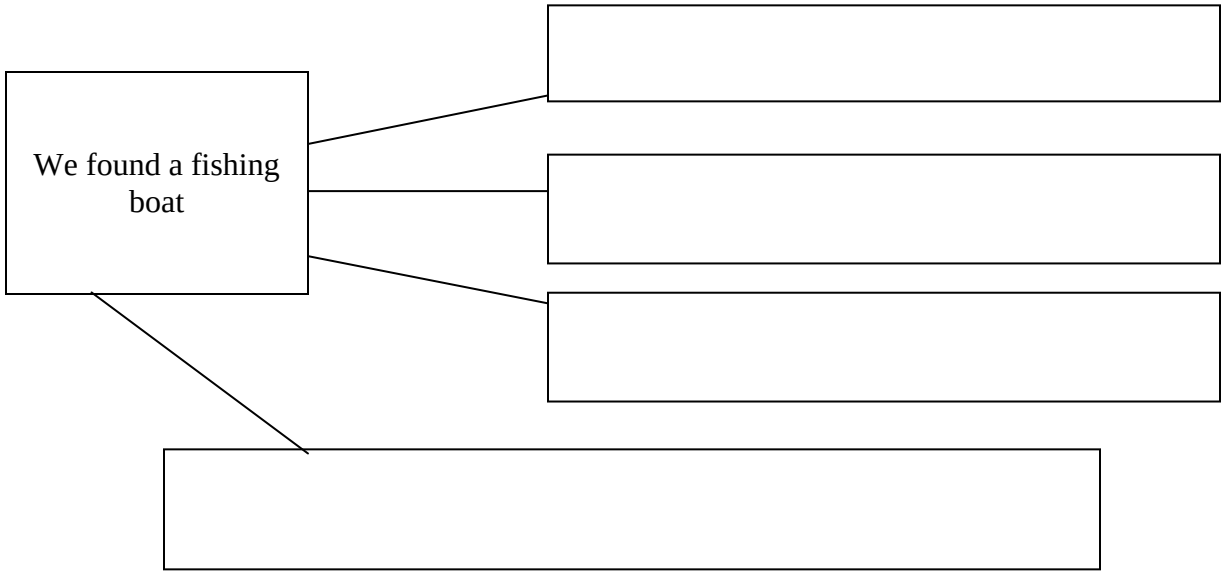
The storm was approaching fast, and THIS LED TO Haley and her family deciding to take their storm safety kit and travel to Atlanta where her grandparents lived so that they could be safe from the storm. Hopefully they will be able to return home soon, but she is also excited that she will get to visit her grandparents!

Names of group members _____ _____ _____

Fishing Boat

One day last summer, my friend and I discovered a big old fishing boat that had washed up on the beach! As a result, we adopted the boat for the summer. Finding that boat led to a lot of great times making up adventures about being shipwrecked on a deserted island, discovering a new country, and being ocean scientists.

As more of our friends noticed the boat we found, it caused us to begin sharing things we knew about boats and ships and the ocean. Then we decided to use our great adventure stories and write a play about them. We acted it out right in front of the boat for our families and friends. It turned out great! Everyone was amazed that we could write a play and act it out. So were we!



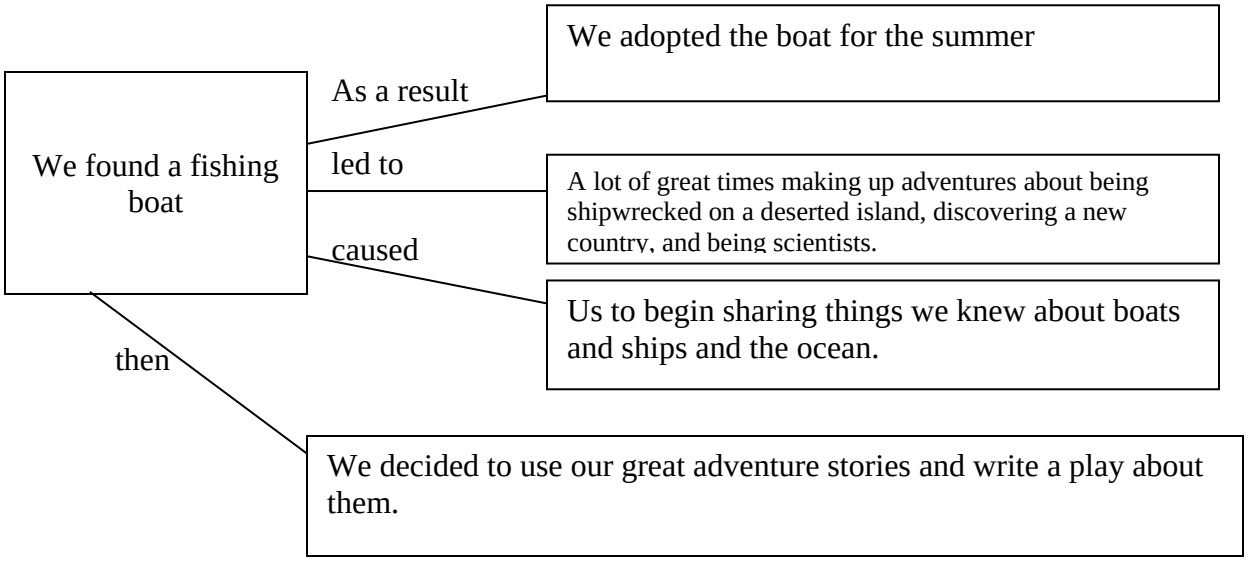
Now write a short summary using the main ideas and the key words

Key

Fishing Boat

One day last summer, my friend and I discovered a big old fishing boat that had washed up on the beach! AS A RESULT, we adopted the boat for the summer. Finding that boat LED TO a lot of great times making up adventures about being shipwrecked on a deserted island, discovering a new country, and being ocean scientists.

As more of our friends noticed the boat we found, it CAUSED us to begin sharing things we knew about boats and ships and the ocean. THEN we decided to use our great adventure stories and write a play about them. We acted it out right in front of the boat for our families and friends. It turned out great! Everyone was amazed that we could write a play and act it out. So were we!



Now write a short summary using the main ideas and the key words

We found a fishing boat and as a result we adopted the boat for the summer. This led to a lot of great times making up adventures about being shipwrecked on a deserted island, discovering a new country, and being scientists. It also caused us to begin sharing things we knew about boats and ships and the ocean, and then we decided to use our great adventure stories and write a play about them.

Step 2: Content-bound, curriculum free practice

Lesson 5: Practice with text structure: Key words & mapping

Literacy Objectives:

Standard VIII: Writing
Objective 1d: Use a variety of graphic organizers to organize information
Objective 6c: Produce informational text (e.g., book reports, compare/contrast essays, observational reports, research reports, content area reports, biographies, summaries).

Materials

Cause/effect key word poster
"Becoming Extinct" text (one copy per 2 students)

Purpose:

The purpose of this lesson is for the students to practice identifying key words and make maps of short one page cause/effect informational (content-bound) texts.

Lesson:

Review with the students the process of finding the cause and effects in a sentence. Have students turn to their neighbors and create sentences with causes and effects, then share as a class, writing them on the board and mapping them out (as in previous lessons).

Refer back to a science/social studies textbook as you did in the beginning. Remind the students that the structure of the text reflects the author's ideas and the relationships of those ideas to one another. Explain how, by learning to identify and use the structure of the texts, they will able to read and study more quickly and effectively and understand and recall the information in the text better.

Assessment:

Pair the students each up with a partner. Give them the text, "Becoming Extinct". Read the directions to the students: "With your partner, read the story "Becoming Extinct". Together decide on the key words that are used and circle them. Then make a map of the cause and effects. You may not have to use all of the key word lines and the effects boxes."

**Save the students' maps, as in the next lesson they will be creating summaries using the maps they have created.

Becoming Extinct

The Badlands Bighorn sheep once grazed on the prairies of North and South Dakota and Nebraska. When the Bighorn sheep were in danger, it caused them to have to climb steep mountains to find safety. Few plants grown on the dry, steep hills of the Badlands, and because of the danger that they were in, many of the sheep did not survive in that they could not find enough food. As a result, the Bighorn sheep started to die. People also hunted these sheep for their large horns and this led to the Badlands Bighorn sheep becoming extinct-meaning that they are no longer found on the earth. The last Badlands Bighorn sheep was seen about 70 years ago.

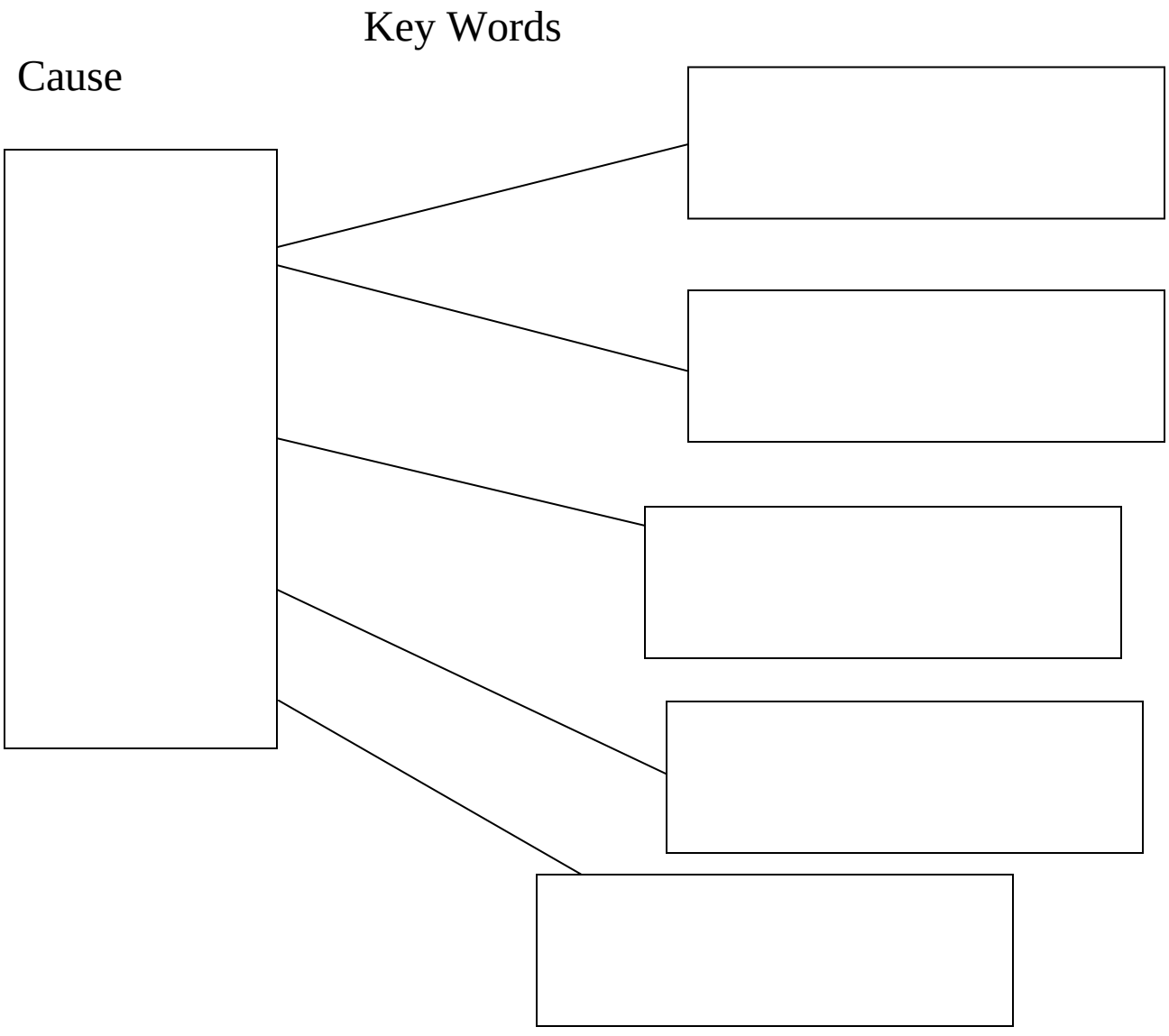
Key

Becoming Extinct

The Badlands Bighorn sheep once grazed on the prairies of North and South Dakota and Nebraska. When the Bighorn sheep were in danger, it CAUSED them to have to climb steep mountains to find safety. Few plants grown on the dry, steep hills of the Badlands, and BECAUSE of the danger that they were in, many of the sheep did not survive in that they could not find enough food. AS A RESULT the Bighorn sheep started to die. People also hunted these sheep for their large horns and THIS LED TO the Badlands Bighorn sheep becoming extinct-meaning that they are no longer found on the earth. The last Badlands Bighorn sheep was seen about 70 years ago.

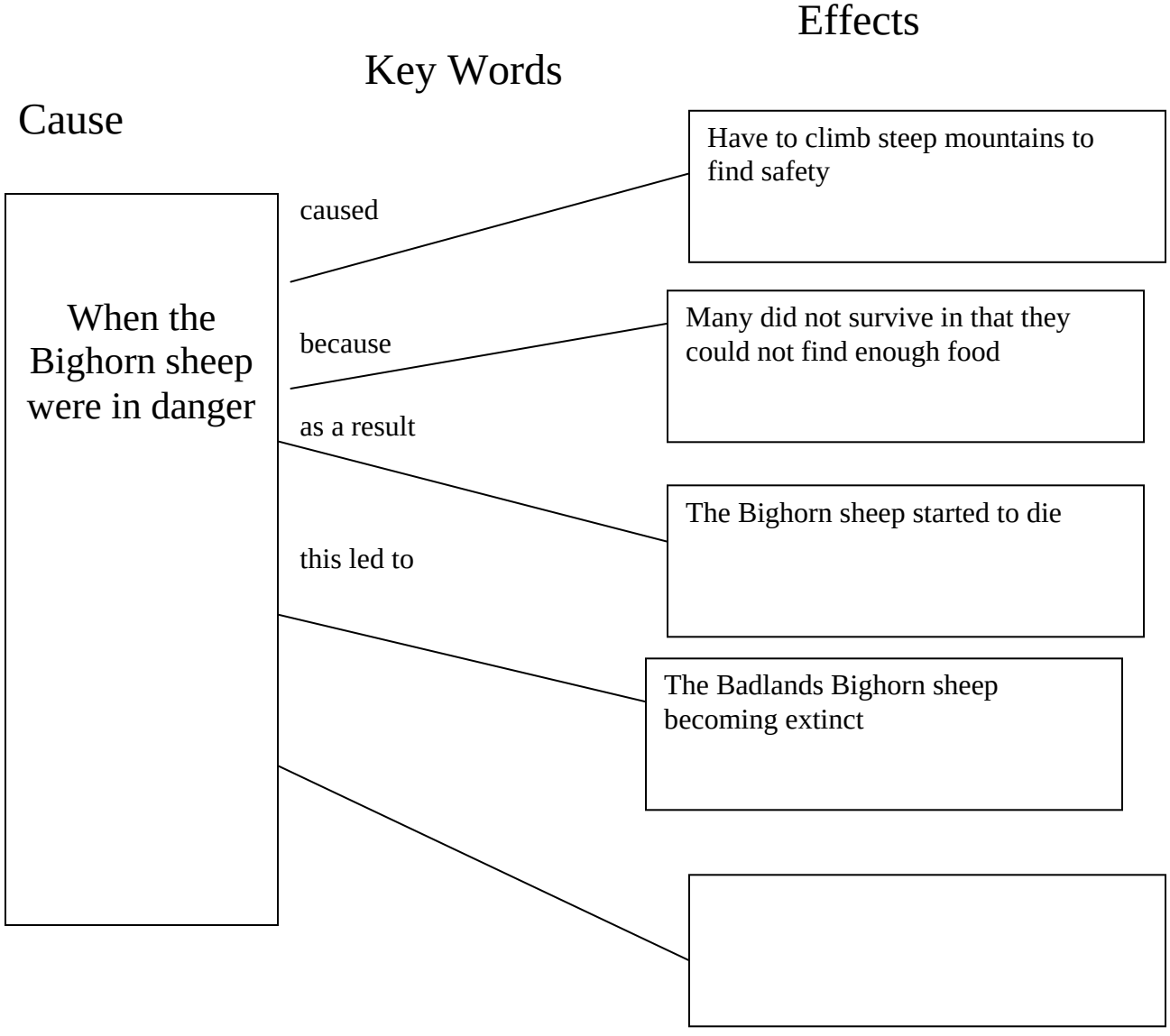
Names: _____ _____

With your partner, read the story “Becoming Extinct”. Together decide on the key words that are used and circle them. Then make a map of the cause and effects. You may not have to use all of the key word lines and the effects boxes.



Key

With your partner, read the story “Becoming Extinct”. Together decide on the key words that are used and circle them. Then make a map of the cause and effects. You may not have to use all of the key word lines and the effects boxes.



Lesson 6: Practice with text structure: Summarizing

Literacy Objectives:

Standard VIII: Writing
Objective 1d: Use a variety of graphic organizers to organize information
Objective 6c: Produce informational text (e.g., book reports, compare/contrast essays, observational reports, research reports, content area reports, biographies, summaries).

Materials

Cause/effect key word poster
"Becoming Extinct" text (from previous lesson)
"Becoming Extinct" student maps (from previous lesson)
"Becoming Extinct" handout (one copy per 2 students)

Purpose:

The purpose of this lesson is for the students to produce summaries of short one page cause/effect informational (content-bound) texts.

Lesson:

Remind the students of how to produce a summary from a map they have created by referring back to the example that they had practice with in a previous lesson (Lesson 4- "Fishing Boat"). Choose one of the examples to review and talk about as a class, and then randomly hand out the examples for students to review. After students have had a chance to review how to summarize, collect the papers.

Tell the students that they will now have a chance to write a summary for the text "Becoming Extinct", which they had practice with mapping in the previous lesson. Have the students get with the partner that they were with in the previous lesson, and hand their maps of "Becoming Extinct" back to them.

Assessment:

Have students create a summary from the text "Becoming Extinct". After everyone is finished, have the students share with the class.

Names: _____ _____

Summary

Cause/Effect text

Using the story “Becoming Extinct”, and the map you created, write a summary including the main ideas and the key words.

Key

Summary

Cause/Effect text

Using the story “Becoming Extinct”, and the map you created, write a summary including the main ideas and the key words.

When the Bighorn sheep were in danger, it caused them to have to climb steep mountains to find safety. Because of the danger that they were in, many did not survive in that they could not find enough food, and, as a result, the Bighorn Sheep started to die. This led to the Badlands Bighorn Sheep becoming extinct.

Lesson 7: Practice with text structure: Key words, mapping, & Summarizing

Literacy Objectives:

Standard VIII: Writing
Objective 1d: Use a variety of graphic organizers to organize information
Objective 6c: Produce informational text (e.g., book reports, compare/contrast essays, observational reports, research reports, content area reports, biographies, summaries).

Materials

"Why We Trade" handout

Purpose:

The purpose of this lesson is for the students to practice on their own, identifying key words, make maps, and produce summaries of short one page cause/effect informational (content-bound) texts.

Lesson:

To review what the students have learned so far, ask volunteers to share how one might go about identifying and summarizing a cause/effect text. Here are some things to prompt them with:

-What are the words called that we look for when we notice that it is a cause/effect text?
-What are some (key) words that you know?
-What are some examples of a single cause/effect sentence?
-What are some examples of a single cause with multiple effect sentences?
-How do you map out the cause/effect text?
-How do you create a summary of a cause/effect text?

Assessment:

Tell students that they are now going to get a chance to practice putting everything together with a social studies text. Hand out the text "Why We Trade", and have the students individually read the text, map it out, and then create a summary.

Name: _____

Read the introduction about Why We Trade. In the section "How Trade Links Communities", circle the key words that you find and then create a map. After you have your map finished, create a short summary of what you read.

Why We Trade (Introduction)

A **marketplace** is any place where people sell things and buy things. A farmers' market is a marketplace. So is a shopping mall. When countries trade, we say they are using the **global marketplace**.

Everyone wants and needs different things. Nobody can actually make *everything*. This is why people come together in marketplaces—to get things they cannot make themselves.

How Trade Links Communities

Suppose a forest in Canada was struck by fire, then Canada would run short of wood to sell. There would be a scarcity of wood. Because of this, a scarcity of lumber in Canada would affect homebuilders in California. They would then not have much work to do and as a result, would have less money to buy things.

Suppose some of those things are made in China. When people in California do not buy as much, then Chinese factories might have to lower prices. A scarcity of wood in Canada would lead to affecting workers in Canada, the United States, and China!

Key

Read the introduction about Why We Trade. In the section “How Trade Links Communities”, circle the key words that you find and then create a map. After you have your map finished, create a short summary of what you read.

Why We Trade (Introduction)

A **marketplace** is any place where people sell things and buy things. A farmers’ market is a marketplace. So is a shopping mall. When countries trade, we say they are using the **global marketplace**.

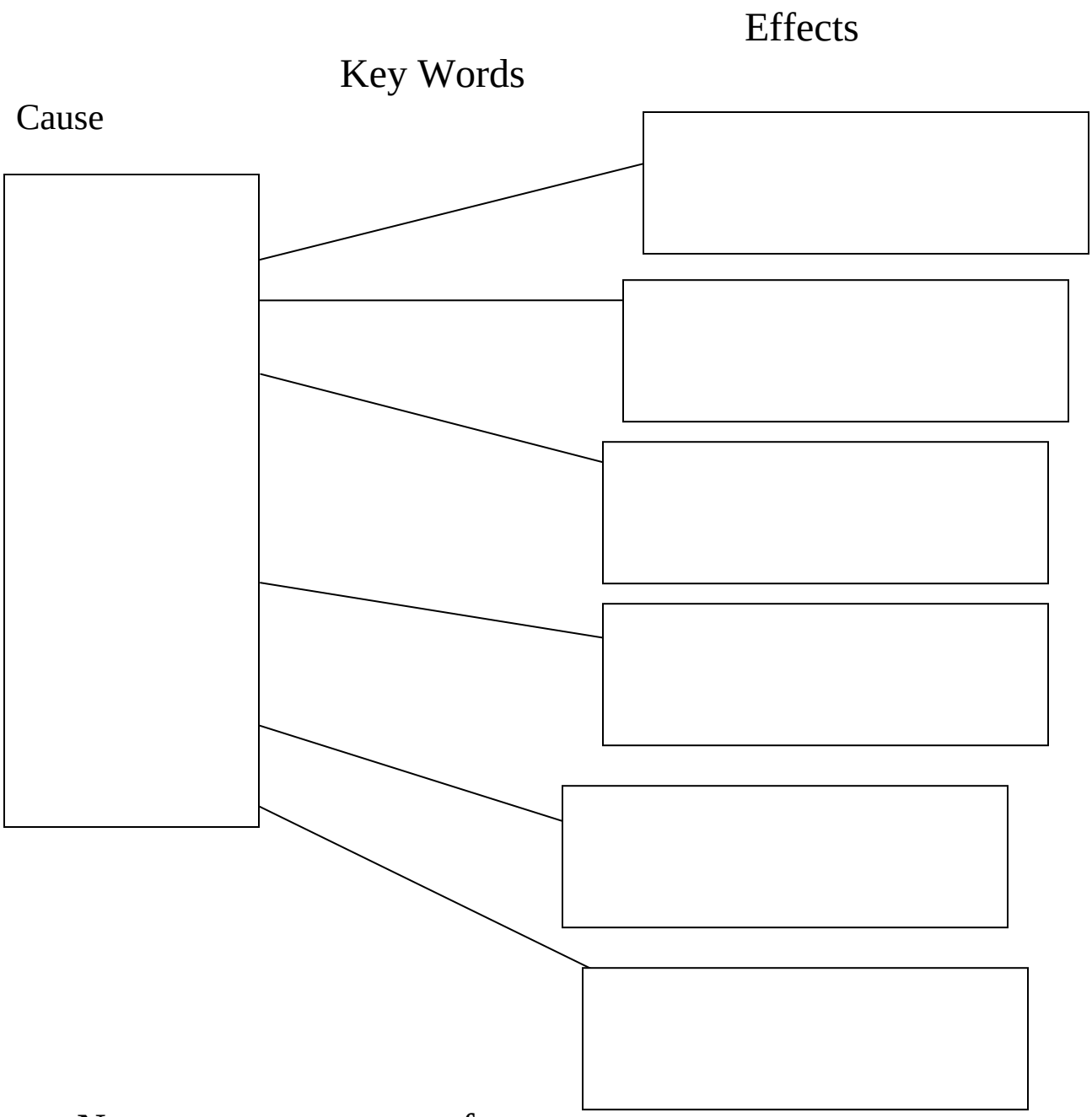
Everyone wants and needs different things. Nobody can actually make *everything*. This is why people come together in marketplaces—to get things they cannot make themselves.

How Trade Links Communities

Suppose a forest in Canada was struck by fire, THEN Canada would run short of wood to sell. There would be a scarcity of wood. BECAUSE OF THIS, a scarcity of lumber in Canada would affect homebuilders in California. They would THEN not have much work to do and AS A RESULT, would have less money to buy things.

Suppose some of those things are made in China. When people in California do not buy as much due to the fire, THEN Chinese factories might have to lower their prices. A scarcity of wood in Canada would LEAD TO affecting workers in Canada, the United States, and China!

Map for “How Trade Links Communities”



Now create a summary for your map

Key

Map for "How Trade Links Communities"

Effects

Key Words

Cause

Suppose a forest in Canada was struck by fire

then → Canada would run short of wood to sell

Because of this → A scarcity of lumber in Canada would affect homebuilders in California

Then → not have much work to do

As a result → would have less money to buy things.

Then → Chinese factories might have to lower prices.

This would lead to → affecting workers in Canada, the United States, and China

Now create a summary for your map

Suppose a forest in Canada was struck by fire, then Canada would run short of wood to sell. Because of this, a scarcity of lumber in Canada would affect homebuilders in California and then they would not have much work to do. As a result, they would have less money to buy things, and then Chinese factories might have to lower prices. This would lead to affecting workers in Canada, the United States, and China.

APPENDIX C

SCIENCE, INTEGRATED TEXT STRUCTURE LESSONS, AND NOTEBOOK: STEP 3

Science Outline: Weather Fourth Grade				
Day	**Lesson**	**Activity**	**Text lesson** (Experimental group only)	**Purpose**
1	Rules & Expectations	Expectations, Pre-test, Science notebooks, Unit introduction	None	Students will learn the rules and expectations of Science rotations, take a pre-test, and how to use their Science notebook.
2	Weather Introduction	Power point	None	Students will learn the impact weather has on us every day.
3	The Sun and our Atmosphere	Soil, water in fridge to see which cools down faster	None	Students learn that soil cools down and warms up faster than water which affects the weather in Utah since we don't have the ocean close.
4	Meteorologists	Meteorologist video, meteorologist worksheets	None	Students learn about what a meteorologist does.
5	Air is a substance	Air experiments	None	Students learn that there is proof all around us that air is a substance and it takes up space.

6	Temperature	Make own thermometers, practice reading a thermometer	While reading a thermometer, you notice that the temperature has fallen throughout the day. What might be the cause of this?	Students investigate the use of a thermometer.
7	Weather in Utah PART 1	Discuss average temperatures for each season and type of precipitation	Precipitation cause & effect review A destructive windstorm that carries large objects into the air. As a result, these objects then fall onto things like houses, trees, and roads, causing destruction. Tornadoes are dangerous, and we must be in a safe place while a tornado is near.	Students learn about the weather and the change of the seasons.
	Severe Weather PART 2	Lessons on various severe weather phenomena…Utah's Severe Weather video with Dan Pope (library has a copy)		Students learn about and compare the different components of severe weather and normal weather conditions.
8	Air Pressure	Make barometers	None	Students learn that a falling barometer is a clue that a storm might be coming.
9	Wind	Make wind vanes	Wind can cause relief, or it can cause disaster.	Students learn that moving air is called wind, and that knowing wind direction and speed can help scientists predict how the weather will change.

10	Clouds PART 1	Cloud making in a jar	None	Students learn that clouds are formed from rising warm air cooling, hitting dust, changing to water and the water creating a cloud.
	Types of Clouds PART 2	Make examples of three cloud types with cotton balls on blue construction paper		Students will be able to identify the three types of clouds: Cirrus, Cumulus, and Stratus.
11	Precipitation	Discussion of types of precipitation and what precipitation occurs with various temperatures. Show a rain gauge and teach how it is used.	None	Students learn that precipitation is necessary for our survival, and that rain can be measured with a rain gauge.
12	Weather Fronts and Weather Charts	Practice predicting the weather or time of year by looking at a chart of weather information with various clues. Show weather fronts on a map and teach that fronts move in the general direction of west to east	When cold air mass moves under a warm air mass, it moves upward and begins to cool. It condenses to water vapor and as a result, forms clouds. This may cause rain and thunderstorms to develop, and the air temperature will become cooler as the cold air mass moves forward. As warm air moves over cold air , it slides up over the cold air as it moves forward. The warm air moves slowly and as a result, the warm fronts bring steady rain instead of thunderstorms, followed by clear, warm weather as the warm air mass moves over the area.	Students learn that cold fronts and warm fronts affect weather usually by creating storms, and they are represented differently on weather maps. Students also learn how temperature and air pressure affect weather.
13	Bill Nye on Water Cycle/Weather & Review	IMC has several different Bill Nye videos (water cycle, wind, storms, etc.) The library at the school has Bill Nye and the water cycle.	None	Students review the weather unit
14	Test	Student assessment	None	Student assessment

Lesson 1: Rules & Expectations

Materials:
Science folders
Science notebooks
Sticky Notes
K-W-L posters labeled, "The Water Cycle", and "Weather"
Class rules poster

Purpose:
Students will learn the rules and expectations of Science rotations, how to use their Science folders and notebook, and will be introduced to the science units.

Anticipatory Set:
Tell students that in this science rotation, they will be learning about weather. Have students open up to pg. 2 in their science notebook "What do you know?" Take about 2-4 minutes for students to write down responses to "What do you know about weather?" When the time is up, ask students to talk with their neighbors about things that they already know about our topic of study.

After everyone is finished writing and talking, have students choose something from their writing to copy down on a sticky note and come up and add to the K (Know) column on both of the charts labeled "Weather".

After everyone is finished, direct their attention to the K-W-L charts. Read off a few of the items listed on both charts, and tell students that we will have an opportunity to learn a lot more about these things in this unit. Now have students take a minute to write in their notebooks any questions that they have about the units in their notebooks. Invite the students to write down one of their questions on a sticky note and add it to the W (want to know) column on the chart. Review these questions with the students, and tell the students that we hopefully will get the chance to answer each and every question as we learn about these things throughout our unit of study.

Input:
Remind students of the class rules.
One of the things that scientists have to do is to be very organized in collecting their data. For this unit, we will be using notebooks to record and collect information that we learn about from the water cycle and about the weather.

Show students the notebook. Students will be using the notebook for activities that they will be participating in throughout the unit. They will get to start decorating their notebooks today. Talk about use of the notebooks.

Direct students attention to the 'team tote' on the desk that they are sitting on. That tote means that the person that sits at that desk is the 'team captain' for their science team. They are responsible to help pass out papers and materials for their team. The team captain is also in charge of handing out the folders as soon as they walk in the classroom at the time of rotations, and are also responsible for putting the folders away in the right place.

Activity:
Pass out the science folders and notebooks to the students. Have them neatly write their first and last names on their science folders in the top left hand corner of their notebook.

Remind students of the topic that we will be studying in this unit by writing it on the board:

Weather

(Only if there is time)
Students will get to decorate their own notebooks (however, they will need to decorate it according to the things that they learn about in the units).

What do you know?

Weather

What do you know about weather?

Lesson 2: Weather Introduction

Weather Introduction

Materials:
1 piece of paper for each group
Weather Introduction power point (optional—can be just a discussion)
School House Rocks DVD disc 2 (weather video)
Pictures of Wooly Mammoth, Indians, Pioneers

Purpose: Students will learn the impact weather has on us every day.

Anticipatory Set:
Pose the question, "What is weather?" Invite students to respond, and then have each team open up in their notebooks to pg. 17. Tell them that you are going to give them five minutes as a group to brainstorm a list of words that have to do with the weather. Each student needs to write the words down in their own notebooks. When the five minutes is over, give each group a chance to read their words. Decide as a class if they are 'correct' weather words. If the other teams have any of the words read on their list, they put a check mark by the word. The team in the end that has most words on their list that are not checked off is the winner.

Input:
Weather Introduction power point, or discussion

Show a picture of a wooly mammoth. Thousands of years ago, woolly mammoths lived here in Utah. Why don't they live here now? Scientists believe that during the time of the woolly mammoths, that the weather was cold or cool almost all year long. But weather conditions gradually became warmer and the woolly mammoth could not withstand the warmer weather.

Did weather impact the woolly mammoths? YES!

Show pictures of Indians. More than seven hundred years ago the Fremont and Anasazi Indians lived in Utah. They raised beans, corn, and squash. However, for some reason, they left their homes and never came back. We are not sure why, but scientists believe that there were many years of very little rain about that time and the people moved away because the land was too dry.

Did weather impact the Indians seven hundred years ago? YES!

Show pictures of Pioneers. A little over 150 years ago, the first pioneer people began to come and stay in Utah. The pioneers wondered about the weather in this area. Jim Bridger, a famous Utah Mountain Man who explored much of Utah, told the Pioneers

that he didn't think it would be warm enough to grow crops. He told them not to go. The Pioneers brought weather tools with them so that they could learn about the weather here.

Did weather impact the pioneers? YES!

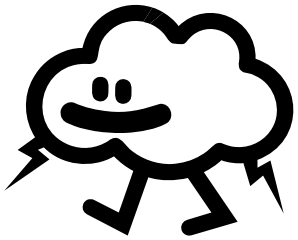
Knowing about weather is important for us even today. When you go to school or on a family trip, knowing what the weather will be like helps you choose what to wear. Going to Lagoon on a warm sunny day is more fun than during a thunderstorm. In fact, Lagoon closes in the winter because of the cold weather. Weather is important to every day life. During the next few weeks, we are going to be learning a lot about weather.

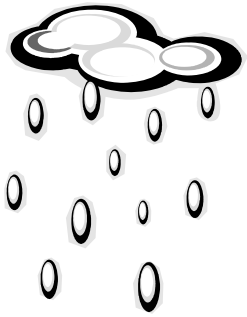
Activity:
Watch the weather video of School House Rocks (It is short…2 minutes long).

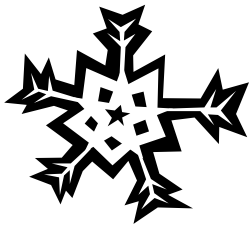
Closure/Assessment:
Read the book: "Cloudy With a Chance of Meatballs".

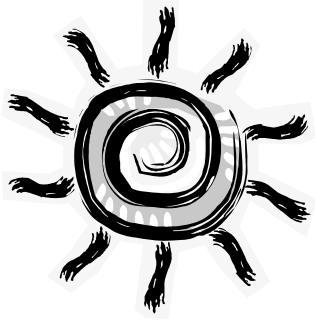
What is weather?

Write down as many words you can that have to do with weather









Lesson 10: The Sun and our atmosphere

Standard 2: Students will understand that the elements of weather can be observed, measured, and recorded to make predictions and determine simple weather patterns.
Objective 1c: Investigate evidence that air is a substance (e.g., takes up space, moves as wind, temperature can be measured).
Objective 3: Evaluate weather predictions based upon observational data
Objective 3a: Identify and use the tools of a meteorologist (e.g., measure rainfall using rain gauge, measure air pressure using barometer, measure temperature using a thermometer).

Materials:
Song on CD (Here Comes the Sun)
1 plastic cup
Soil
Room temperature water
1 thermometer
Science notebooks

Purpose:
Students learn that soil cools down and warms up faster than water which affects the weather in Utah since we don't have the ocean close.

Anticipatory Set:
Listen to the song, "Here Comes the Sun" on CD. Ask students to talk within their groups about why the sun is helpful to us on earth. Have them write their answers on pg. 19 in their notebooks (Without the sun, the planet would be cold and dark and nothing would grow).

Input:
The sun affects the weather that we experience every day. The land and the water soak up warmth from the sun. Air is then heated as the land or water releases the heat. Land and water heat up and cool down at different rates so the air heats unevenly. This uneven heating of air causes wind and changes in weather.

Activity:
Take the cup full of soil and the cup of water. Show the students the thermometer and ask them what it is used for (this is a tool that scientists use to measure temperature). Put the thermometer in each cup to take the temperature. They should write down in their notebooks the temperature of the soil and the water. Have the students then write a prediction about which will cool down faster—soil or water. (soil should). Walk with the students to put both cups in the refrigerator and continue with the second part of the lesson. Tell students you will check them at the end of the lesson and see which one cooled down faster.

Input 2:
The earth is covered with a huge layer of air that is always moving. There are 3 layers: Troposphere, Stratosphere, and the upper atmosphere. Weather is what is happening at the bottom of the atmosphere. Tell the students that we are going to draw and label a picture of our atmosphere.

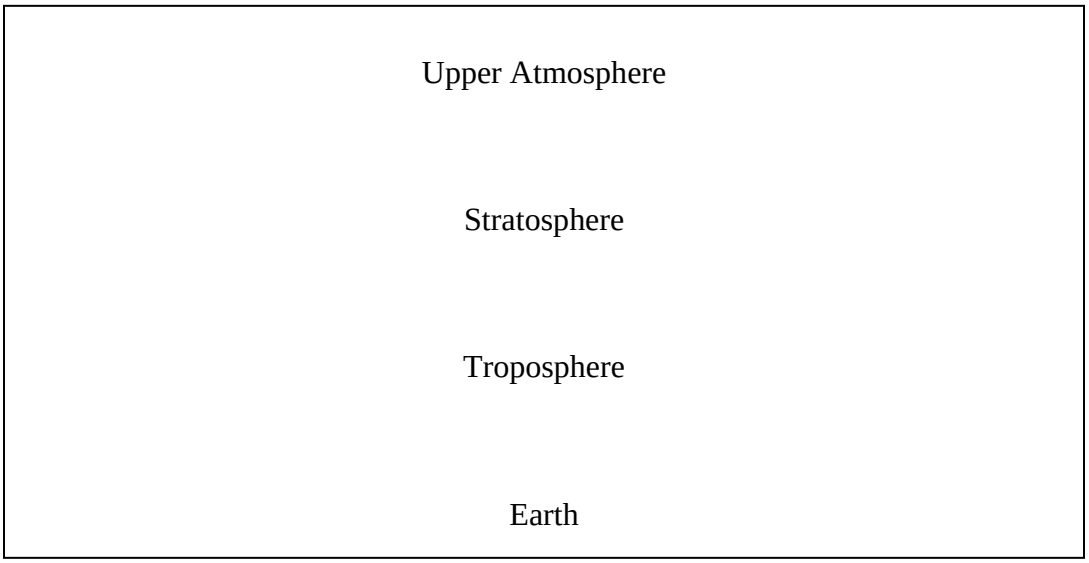
Activity:
Draw a picture on the board while explaining each part of the atmosphere. Have the students copy the picture down in their notebooks. Include this information:

Upper Atmosphere
- -About 400+ miles from the stratosphere to the upper atmosphere
- -Temperatures can go as high as 1,727 degrees Celsius because it's very close to the sun's energy
- -Chemical reactions occur really fast here

Stratosphere
- -Very dry air
- -30 miles from the troposphere to the stratosphere
- -The "ozone" layer-which absorbs dangerous radiation from the sun

Troposphere
- -Where weather happens
- -Contains clouds and vapor
- -7 ½ miles from earth to the troposphere

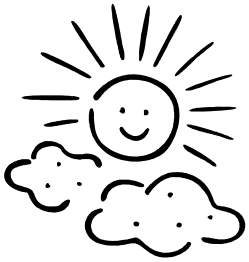
The Atmosphere



Closure/Assessment:
Have students write one sentence in their notebooks about each layer of the atmosphere with a partner. Walk with the students to get the water and the soil and take the temperatures of each (The soil should have cooled down faster). Have students write their observations in their notebooks. Invite students to share their responses about why the soil cooled down faster. Explain that soil always heats up and cools down faster than water does. This makes the air above the soil cool down or heat up faster. This is why places that are closer to the ocean stay cooler in the summers than places do in Utah. The opposite is true in the winter. Places very near the ocean in the winter will not be as cold as places further away.

KEY TEST ITEMS:
1. The troposphere is the part of the atmosphere where weather takes place.
2. The sun is responsible for the weather.

The Sun and our Atmosphere



Write down as many reasons as you can think of about why the sun is helpful to us on earth.

The sun is helpful because

_____

_____

_____

_____

_____

Record the temperature of soil and water so that we can determine which will cool down faster.

Soil: _____ Water: _____

My predictions and observations

I predict	I observed

The earth is covered with a huge layer of air that is always moving.
There are 3 layers: Troposphere, Stratosphere, and the upper atmosphere.

Draw a picture of the atmosphere below

The Atmosphere

Write a sentence describing each layer in the atmosphere.

The Upper Atmosphere…

_____

_____

The Troposphere …

_____

_____

The Stratosphere…

_____

_____

Lesson 11: Meteorologists

Standard 2: Students will understand that the elements of weather can be observed, measured, and recorded to make predictions and determine simple weather patterns.
Objective 3: Evaluate weather predictions based upon observational data.
Objective 3b: Describe how weather and forecasts affect people's lives

Materials:
Weather Lore Transparencies
"Weather" book by Seymour Simon
Meteorologist Article (teacher copy)
Meteorologist Article with missing words (copies for each student)
Meteorologist video
Meteorologist Magnifying Glass sheet (copies for each student)
Science notebooks

Purpose:
Students learn about what a meteorologist does.

Anticipatory Set:
Ask the students if they know what a meteorologist is (A scientist who studies and reports the weather).

Input:
People try to predict the weather sometimes using 'weather lore' like groundhogs, etc. Show the students the Weather Lore transparencies.

A meteorologist forecasts (predicts) the weather. They use many different tools to do this: satellite, radar, and weather balloons. A weather balloon is like a huge hot air balloon that is equipped with weather tools. Meteorologists send it up into the atmosphere so that it can gather information. When they bring the balloon back down, they are able to look at the tools and gather information about the weather. Show students the picture of the weather balloon from the book called, "Weather" by Seymour Simon.

Since there are so many things that affect weather, sometimes meteorologists are wrong and forecasting can NEVER be 100% accurate (correct). However, meteorologists warn people of danger ahead of time…like hurricanes and storms.

Activity:
Watch the tape that shows the meteorologists and their forecasts from the news (There are two different ones). These clips are from a few years ago, but it will give students a chance to watch a forecast and see what a meteorologist does.

Read, "Meteorologists" to the students (from their notebooks). Read slowly the teacher copy of the article to them, and have the students fill in the missing words in their

notebooks. At the end, have the students turn to their groups and go through together what the missing words are. Then as a class, go over the missing words. Have students then get with a partner to use the missing words to create a short summary to describe a meteorologist.

Closure/Assessment:
Looking at "A Closer Look at a METEOROLOGIST" in their notebooks, have students answer the two questions "What does one do, and would you like to be one?"

KEY TEST ITEMS:
1. If the meteorologist predicts a nice day for the day that your family has planned a trip to the zoo, and it rains, what went wrong?
    -Weather has many factors that change quickly and so forecasts can never be 100% accurate.
2. The most important goal of weather forecasting is to save lives and property.
3. Uncle Rob says that when cats sleep all day, it will rain the next day. How is his forecast different than that of a meteorologist?
    -He is not using scientific evidence or tools.

Meteorologists

Lights, camera, action! That is what most people think of when they think of TV. Most people think that the only thing a TV weathercaster or METEOROLOGIST does is stand in front of the camera and point to weather maps. But this is one of the easier things that a meteorologist does. A WEATHER BROADCAST on TV usually only takes a few minutes. However, getting ready for the broadcast may take hours since meteorologists have to gather information about the weather before they can tell us the FORECAST.

Meteorologists use SATELLITE and RADAR data to assist them in predicting both short term and long-term weather forecasts. You have probably noticed radar and satellite photos on the local news during the weather segment. Scientists also fill large BALLOONS with helium. These balloons are equipped with special WEATHER TOOLS. The balloons are sent high into the ATMOSPHERE where information can be gathered to help meteorologists make accurate weather forecasts.

Being a meteorologist is an important job. One of the most important goals of weather forecasting is to SAVE LIVES and PROPERTY. If a hurricane is coming, a meteorologist can warn people in advance. If a large snowstorm is coming, they can give people advance notice so that they can be prepared. Recorded weather information is very important to all people. FARMERS use the information to know when to plant crops. HOMEOWNERS know when they can plant flowerbeds based on the weather information. People plan

VACATIONS around weather information. SCIENTISTS use weather data to help plan rocket launches and to see if climate is changing. A lot of people depend on the information that meteorologists give us.

Many people believe that you can't see into the future. Perhaps they are thinking about magic and crystal balls. Good meteorologists do indeed predict the future, however, you probably know that sometimes they are WRONG. It might even cause you some grief when your plans have to change because of an incorrect forecast. Let's say that you have planned a trip to the zoo with your family. You watch the weather forecast and it says it will be clear weather. But when you wake up the next morning, it is raining instead. The meteorologist was probably wrong because there are so many WEATHER FACTORS that can change very quickly. More technology and better weather tools have lead to more accurate forecasts, however, because there are so many things that can affect the atmosphere and change weather patterns, weather forecasting will probably NEVER be 100% CORRECT. Even though predicting the weather is never completely correct, you might be surprised at how good you can get at predicting tomorrow's weather!

So, the next time your Uncle Rob says that if the cat sleeps all day, it will rain the next day…will you think his prediction is accurate? Hopefully not. His forecast did not use scientific EVIDENCE or tools. When you want accurate and useful weather forecasts, turn on your local news and see what the meteorologist has to say! And, who knows, maybe someday you'll be that meteorologist!

With a partner, use the missing words you filled in and create a small summary to describe a meteorologist.

A meteorologist…

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

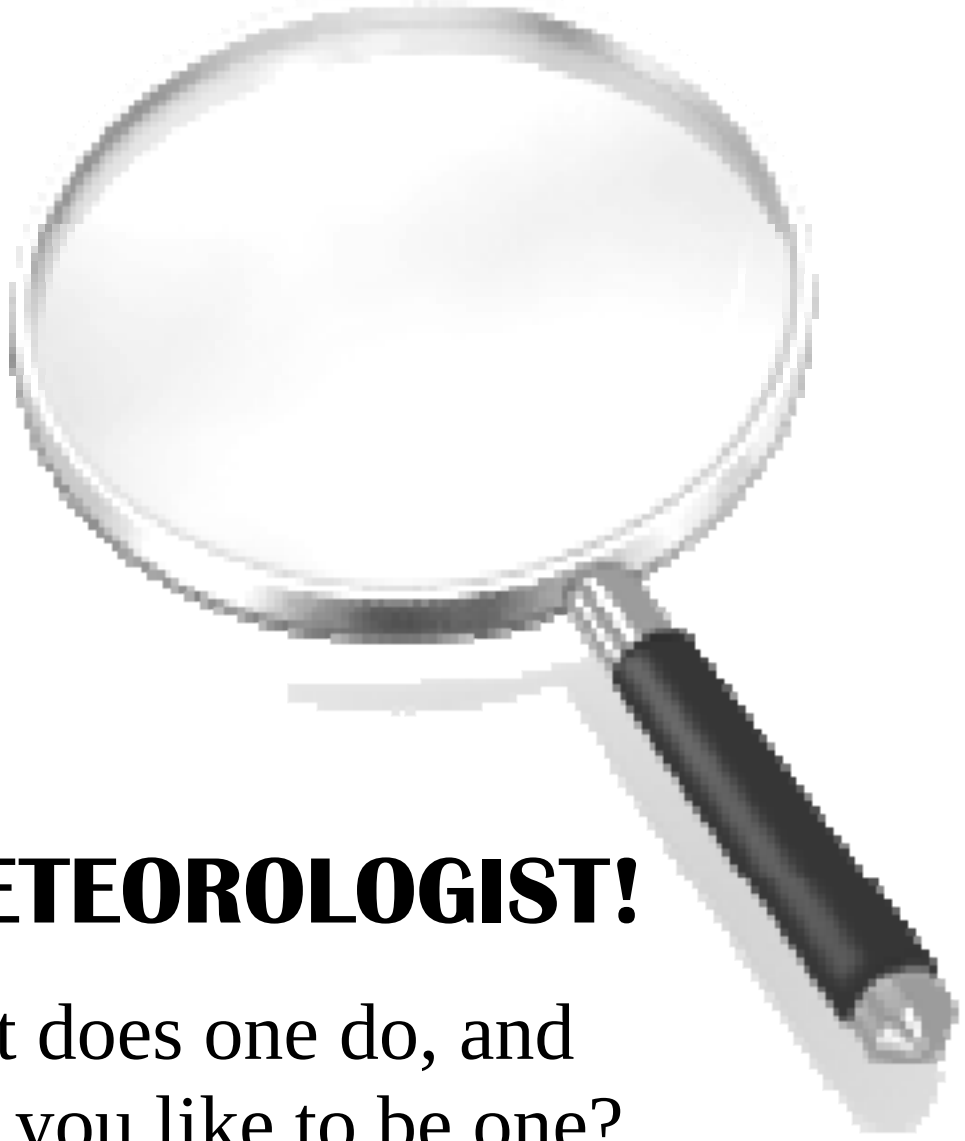
_____

_____

_____

_____

A closer look at....



...a METEOROLOGIST!

What does one do, and would you like to be one?

Answer these questions in the magnifying glass

Lesson 12: Air is a substance

Standard 2: Students will understand that the elements of weather can be observed, measured, and recorded to make predictions and determine simple weather patterns.
Objective 1: Observe, measure, and record the basic elements of weather.
Objective 1c: Investigate evidence that air is a substance (e.g., takes up space, moves as wind, temperature can be measured).

Materials:
Experiment 1:
- 1 balloon
- 1-two liter bottle

Experiment 2:
- Full sheets of newspaper
- Ruler

Experiment 3:
- Potato
- Straw

Experiment 4:
- Dry paper towels
- Clear plastic cup
- Bowl with water

Experiment 5:
- 2 balloons blown up to basically the same size
- 1 ruler, hanging off a hanger
- String

Science notebooks

Purpose:
To teach students that there is evidence all around us that air is a substance and it takes up space.

Anticipatory Set:
Have students open up in their notebooks to pg. 24 and answer the questions about air. Then have class discussion about their answers.

Input:
Tell the students that today we are going to do five experiments to find out if air does take up space and if it has weight. Tell them to pay careful attention to the role that air is playing in each one.

Activity: (Teacher conducted experiments)
Conduct Experiments.
#1—Balloon in 2 liter bottle.
Ask who is good at blowing up balloons and choose one person to volunteer to blow up the balloon inside the bottle.
A. Before the student tries to blow up the balloon, have the students write down a prediction in their notebook of what will happen.
B. Student tries to blow up balloon.
C. What really happened? (The balloon would not blow up).
D. Explain. Ask students to think about why the balloon would not blow up. Have them talk with their neighbors for a minute, and then discuss as a class. Then have the students write down their observations (The balloon will not blow up because there is already air in the 2 liter bottle that is taking up space. There is not room for the balloon to blow up).
E. This is evidence that…air takes up space.

#2—Heavy Air: Newspaper and ruler experiment
A. Lay the newspaper open and flat on a table. Place the ruler under the center (see the picture on the instruction page)
B. Ask the students to make a prediction of what will happen when you hit the ruler. Have them write their prediction in their notebooks.
C. Hit the ruler quickly (not too hard or the ruler will break. The newspaper should stay down).
D. What really happened? The newspaper stayed down on the table.
E. Explain. Have students talk with their neighbors for a minute, and then discuss as a class (The newspaper stayed down because air pressure is pushing down on the newspaper and holding it in place. If you push the ruler slowly, air gets underneath and pushes the paper up).
F. This is evidence that…air has weight.

#3—Which one is holding nothing?
A. Have 4 different Ziploc baggies on the table. Bag #1 should have a solid in it such as a block of wood, etc. Bag #2 should have water in it. Bag #3 should have air in it to form a 'pillow'. Bag #4 should be completely flat with nothing in it.
B. Show students each of #1-#3 bags, and ask, "Which bag is holding nothing?" (They will think it is the pillow of air). Have students write down their predictions.
C. Then show the students the #3 bag and the #4 bag. Ask, "If this one (pillow) has nothing, then what does this (#4) have? Ask students to write down their observations.
D. Explain. Help them understand that the #4 bag really has nothing, but the 'pillow' is evidence that air takes up space.

#4—Dry paper towel
A. Show the bowl of water and a clear plastic cup. Wad up a piece of dry paper towel and put it in the plastic cup.
B. Ask the students what they think will happen if you put the cup (mouth down) into the water. Have them make a prediction and write it in their notebooks.

C. Push the cup straight down into the water and then take the cup straight out without tipping the cup at all. The paper towel should not get wet.
D. What really happened? Have students talk with their neighbors for a minute, and then discuss as a class that the paper towel did not get wet because there was air in the cup below the paper towel. Have students write down their observations in their journal.

#5—Tip the scale
A. Show the ruler and balloons hanging off the ruler (it is supposed to look like a scale but you can't ever get the scale perfectly even—if this happens, just have the students imagine it is even).
B. Ask the students to make a prediction of what will happen if you pop one of the balloons. Have them write their prediction in their notebooks.
C. Have a student come up with a push pin and pop one of the balloons.
D. What really happened? Have students talk with their neighbors for a minute, and then discuss as a class that the ruler went more off balance because the balloon and air on the one side are gone.
E. This is evidence that…air has weight.

Closure/Assessment:
Have students revisit their notebooks and made additions to their ideas learned on the evidence from the experiment. There is evidence all around us that air is a substance and takes up space. Have students write a paragraph in their notebooks about what they learned about air.

KEY TEST ITEMS:
1. The end of a syringe can be closed with a finger. When the plunder is pushed, it will only go part way. Why?
-The syringe is full of air.

Experimenting with Air

How do we know that there is air around us even when we can't see it?

Does air weigh anything?

Does air take up space?

Experiments with Air

#1 _____

My predictions and observations

I predict	I observed

#2 _____

My predictions and observations

I predict	I observed

#3 _____

My predictions and observations

I predict	I observed

#4 _____

My predictions and observations

I predict	I observed

#5 _____

My predictions and observations

I predict	I observed

Write about what you learned today about air.
Today I learned that…

_____

_____

_____

_____

_____

Lesson 13: Temperature + Cause/Effect lesson

Standard 2: Students will understand that the elements of weather can be observed, measured, and recorded to make predictions and determine simple weather patterns.
Objective 1: Observe, measure, and record the basic elements of weather.
Objective 1c: Investigate evidence that air is a substance (e.g., takes up space, moves as wind, temperature can be measured).

Materials:
Thermometer
Brown paper sack
3-4 tools in each sack (hammer, pliers, can opener, thermometer)
Large poster of thermometer
Glass beakers
Rubber stoppers
Plastic tubes attached to rubber stoppers
Water
Food coloring
Thermometer worksheet
Thermometer worksheet transparency
Science notebooks

Purpose:
Students investigate the use of a thermometer.

Anticipatory Set:
Have a bag of 3-4 tools (hammer, pliers, can opener, thermometer) for each team. Have students pull one out at a time and discuss in their groups how they are used as a tools. Afterwards, discuss them as a class.

Input:
A thermometer is a weather tool used to measure temperature. Remind students of the thermometer we used when we took the temperature of soil and water. Show the poster of the large thermometer and how it works. Explain the difference between Fahrenheit and Celsius. Most of the world uses Celsius. The United States uses Fahrenheit. At 32 degrees Fahrenheit, water freezes. At 0 degrees Celsius, water freezes.

Activity:
Make thermometers (1 per table)
Give each table a glass beaker and a rubber stopper with plastic tubes inserted. Have the students put the water in the glass beaker (Up to the 100 line). When they have the water in the beaker, go around to each table and put in a couple of squirts of food coloring (the color doesn't matter-red is good because it is the color in thermometers). Then, have the students put the stopper in the beaker and press it in tightly (tell them not to push too hard of they will break the bottle and possibly get hurt). Go around and push the rubber

stopper in each bottle until water travels up the tube. Have students draw a picture of what they observe.

Take the students outside and have them notice what happens with their thermometer. Have them record their observations in their notebook (If it is cold outside, the water should go down). Have the students get in groups and make predictions in their notebooks on how they might get the water to go back up their tubes (The students can make the water go back up the tube by holding the bottle in their hands and warming it back up. The water should also travel back up the tube when the students get back inside because it is warm). Have students record in their notebooks their observations. As a class, discuss what temperatures/seasons are considered hot and cold for Utah weather.

Closure/Assessment:
Show students an overhead to show them how to read a thermometer, then hand out each team 5 examples of Fahrenheit temperatures, and 5 examples of Celsius temperatures. Have students work together to read the thermometers and write them in their notebooks.

CAUSE/EFFECT LESSON:
Temperature scenarios

Have students open up in their notebooks to "Temperature scenarios". At the top of the page, it reads:

While reading a thermometer, you notice
that the temperature has fallen
throughout the day.
What might be the cause of this?

Direct students attention to the key words poster on the board. Remind them that when writing a cause/effect statement, it is important to include key words to help the reader determine what the causes and effects are. Have students in their groups write one cause and effect statement to respond to the statement on the scenario paper, and then have them write one statement on their own without help from their group.

KEY TEST ITEMS:
1. Students need to know that when a temperature is recorded, it looks like: 34ºF.

Using a Thermometer

As you are experimenting with thermometers, record your observations.

I predict the temperature outside to be: _____

The actual temperature was: _____

Draw a picture of what you observe	Describe what you observed

My predictions and observations

I predict	I observed

Matching Temperatures

1. Record the temperature on each thermometer.

#	Fahrenheit
1	
2	
3	
4	
5	

#	Celsius
1	
2	
3	
4	
5	

2. Now use the thermometer with both Fahrenheit and Celsius on it. For each Fahrenheit temperature, find its match in Celsius

Fahrenheit	Celsius

Temperature Scenarios

While reading a thermometer, you notice that the temperature has fallen throughout the day. What might be the cause of this?

Discuss with your group the cause for the temperature on the thermometer to fall, then create one cause/effect statement below. Make sure you are using key words! Underline the key words that you use.

_____

_____

_____

_____

Now create your own cause/effect statement that is different from the one above without the help of your group. Don't forget to underline your key words.

_____

_____

_____

_____

Key

Temperature Scenarios

While reading a thermometer, you notice that the temperature has fallen throughout the day. What might be the cause of this?

Discuss with your group the cause for the temperature on the thermometer to fall, then create one cause/effect statement below. Make sure you are using key words! Underline the key words that you use.

The temperature on a thermometer falling <u>is a result of</u> a cold front coming in.

Now create your own cause/effect statement that is different from the one above without the help of your group. Don't forget to underline your key words.

<u>If</u> there is a thunderstorm, <u>then</u> the temperature on a thermometer will fall.

Lesson 14: PART 1: Weather in Utah + Cause/Effect lesson

Standard 2: Students will understand that the elements of weather can be observed, measured, and recorded to make predictions and determine simple weather patterns.
Objective 2: Interpret recorded weather data for simple patterns.
Objective 2b: Graph recorded data to show daily and seasonal patterns in weather.

Materials:
Thermometer
Season's poster (blank-so it can be filled in)
Copies of mini-books for each student
Crayons, scissors, stapler
Science notebooks

Purpose:
Students learn about the weather and the change of the seasons.

Anticipatory Set:
Have someone take a thermometer outside and place it on the playground. Have them come back in and have the students predict in their notebooks what they think the temperature is outside.

Input:
Ask for 6 volunteers to come up to the front of the room. Explain that there is a reason for weather patterns. 3 students will be the warm air from the equator and the other 3 students will be the cooler air from the north. Have the students mix up and discuss how the mixing of the two kinds of air creates storms.

Every place has unique weather. Ask students what places they have lived where the weather patterns are different than they are here. Ask students to describe those weather patterns, and group states together on the board that they know of that are hotter than others, and have different weather patterns. The weather in Arizona is much different than the weather here. In Utah, you can see all four seasons, but you can't always see all four seasons in other places.

Show the seasons poster. Invite students to suggest different precipitation that they notice in the different seasons such as rain, sleet, hail, snow, wind, etc. Have students talk in groups and record in their notebooks about the kinds of clothes that you would need for each season, the average temperature for each season, and the type of precipitation that is common for each season. Discuss each part of the chart below. Write them on the chart or on the board by the poster.

Summer -Clothes: Short sleeve shirts, shorts, sandals -Average temp: 90 degrees -Common precipitation: Rain, hail -Months: June, July, August	**Fall** -Clothes: Jacket, jeans, t-shirt, long sleeve shirts, shoes -Average temp: 60 degrees -Common precipitation: Rain -Months: September, October, November
Winter -Clothes: Coat, pants, sweater, boots, gloves -Average temp: 32 degrees or below -Common precipitation: Snow -Months: December, January, February	**Spring** -Clothes: Jacket, jeans, t-shirt, shoes -Average temp: 60 degrees -Common precipitation: Rain -Months: March, April, May

After discussing each season, have the students write a short summary of one of the seasons in their notebook.

CAUSE/EFFECT LESSON:
Have students open up in their notebooks to pg. 31. Direct students attention to the vocabulary and cause/effect assignment. As a group, have them match up the precipitation vocabulary words for a review of precipitation and determine the precipitation effect of the causes listed, deciding which are the causes, and which are the effects.

Activity: (If there is time)
Have students make the "Tiny Book About Weather and the Seasons". They color, cut, and staple the books together (Students only cut the page into strips…not into individual squares). After they cut the strips, they fold the strips and put them in order and then staple them together in the middle.

Closure/Assessment:
Have students fill out page 15 in their tiny book—where they write down their favorite season and write words from the 5 senses about that season to describe it. Have students share with their groups what they wrote.

KEY TEST ITEMS:
1. Students need to know that it can be sunny and cold outside at the same time.
2. Students need to know what temperatures are hot for Utah, and what temperatures are cold.
3. Students need to know the seasons and their average temperatures.

Precipitation Review

With your group, match the clue on the left to the term on the right. Write the letter in the blank.

___ frozen rain	A. rain
___ liquid water	B. snow
___ round pieces of ice	C. sleet
___ ice crystals	D. hail

Complete the table below by writing a cause/effect sentence. Don't forget to include a key word! Underline your key words.

Cause	Effect	Sentence
Water droplets become heavy in a cloud	Rain	
Falling rain passes through a layer of freezing air	Sleet	
Water vapor in clouds turns directly to ice	Snow	

Key

Precipitation Review

With your group, match the clue on the left to the term on the right. Write the letter in the blank.

C	frozen rain	A.	rain
A	liquid water	B.	snow
D	round pieces of ice	C.	sleet
B	ice crystals	D.	hail

Complete the table below by writing a cause/effect sentence. Don't forget to include a key word! Underline your key words.

Cause	Effect	Sentence
Water droplets become heavy in a cloud	Rain	If water droplets become heavy in a cloud, then it rains.
Falling rain passes through a layer of freezing air	Sleet	Sleet is a result of falling rain passing through a layer of freezing air.
Water vapor in clouds turns directly to ice	Snow	When water vapor in clouds turns directly to ice, then it snows.

Weather in Utah

Discuss the different seasons with your team members below and fill in the blanks.

Summer -Clothes: -Average temp: -Common precipitation: -Months:	**Fall** -Clothes: -Average temp: -Common precipitation: -Months:
Winter -Clothes: -Average temp: -Common precipitation: -Months:	**Spring** -Clothes: -Average temp: -Common precipitation: -Months:

Using the information above, choose one season and write a summary of the types of clothes usually worn, the average temperature, the common precipitation, and the months of the season.

_____

_____

_____

_____

_____

Lesson 14: PART 2: Severe Weather + Cause/Effect lesson

Standard 2: Students will understand that the elements of weather can be observed, measured, and recorded to make predictions and determine simple weather patterns.
Objective 1: Observe, measure, and record the basic elements of weather.
Objective 1d: Compare the components of severe weather phenomena to normal weather conditions (e.g., thunderstorm with lightning and high winds compared to rainstorm with rain showers and breezes).

Materials:
Weather Phenomena student worksheets
Weather Phenomena overhead
Posters for each group
Books about Weather Phenomena
Video clips of severe weather
Science Notebooks

Purpose:
Students learn about and compare the different components of severe weather and normal weather conditions.

Anticipatory Set:
Write up on the board "Weather Phenomena". Have students discuss with each other what they think this means.

Input:
Weather phenomena are events or conditions that can be observed. Ex) We have just learned about how rain, snow, sleet, and hail different types of precipitation. These are phenomena of the weather. Now we will learn about severe weather phenomena-weather phenomena that are very serious. Brainstorm a list of severe phenomena with your group and record them in your notebook. After groups have had a chance to talk and record examples in their notebook, call on each group to add to the list on the board.

Thunderstorms
Hurricanes
Tornados

Activity:
Watch the video clips on severe weather. Afterwards, give each group a poster, and a book about a certain weather phenomena. Have students read the book together and record information learned on their "Severe Weather Phenomena" worksheets. After reading, students should draw a picture of their weather phenomena and add the information that they learned under their picture.

Closure/Assessment:
Students present their weather poster while everyone else in the class records information about each phenomenon on their worksheet.

CAUSE/EFFECT LESSON:
Have students open up in their notebooks to pg. 33. Direct students attention to the cause/effect paragraph. As a group, have students read the paragraph to determine the cause and effect, and then map it out below.

KEY TEST ITEMS:
1. When the weather forecaster says that a thunderstorm is approaching your town, you should know that dark cumulus clouds, low temperature and rain is coming.

2. Weather clues that show a storm is coming are: wind (especially from the south), cirrus clouds, dropping barometer, and high humidity.

Severe weather phenomena!

List all of the severe weather phenomena that you can think of

_____ _____

_____ _____

Information	What this looks like
1. 2. 3. 4.	
1. 2. 3. 4.	
1. 2. 3. 4.	

Severe Weather-Causes and Effects

Read the selection below.
Circle the key words that you notice, and then identify the cause and effect. Remember that some causes have many effects. After you decide on the cause and effect, map it out below.

A destructive windstorm called a tornado carries large objects into the air. As a result, these objects then fall onto things like houses, trees, and roads, causing destruction. Tornadoes are dangerous, and we must be in a safe place while a tornado is near.

Now map it out:

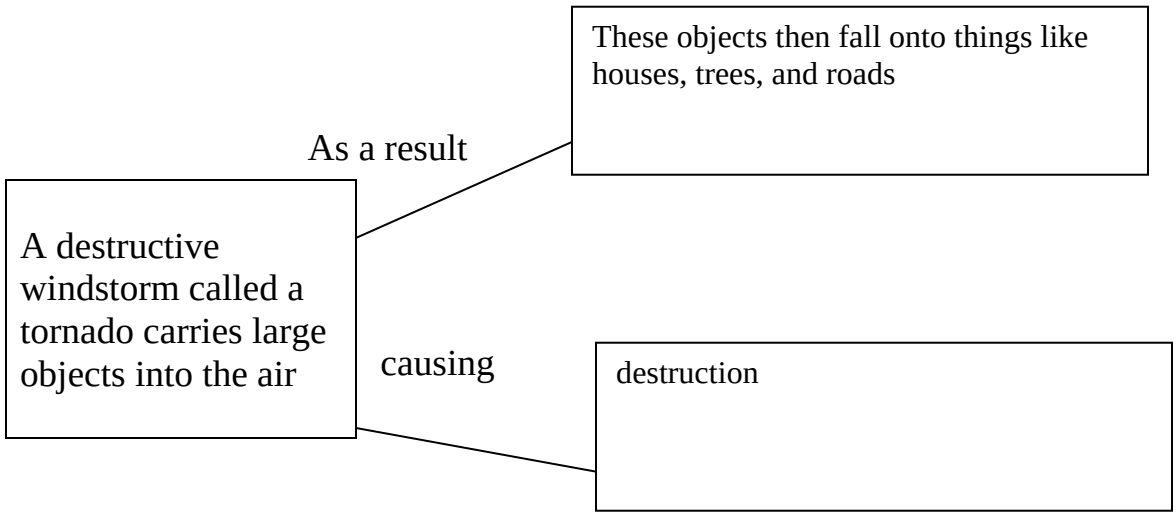
Key

Severe Weather-Causes and Effects

Read the selection below. Circle the key words that you notice, and then identify the cause and effect. Remember that some causes have many effects. After you decide on the cause and effect, map it out below.

A destructive windstorm called a tornado carries large objects into the air. As a result, these objects then fall onto things like houses, trees, and roads, causing destruction. Tornadoes are dangerous, and we must be in a safe place while a tornado is near.

Now map it out:



Lesson 15: Air Pressure

Standard 2: Students will understand that the elements of weather can be observed, measured, and recorded to make predictions and determine simple weather patterns.
Objective 3: Evaluate weather predictions based upon observational data.
Objective 3a: Identify and use the tools of a meteorologist (e.g., measure rainfall using rain gauge, measure air pressure using a barometer, measure temperature using a thermometer).

Materials:
Barometer
Scissors
Balloons
Mason jars
Rubber bands
Plastic straws
Super glue/hot glue
Barometer practice sheets
Barometer instruction sheet
Rulers
Sticky notes
Science notebooks

Purpose:
Students learn that a falling barometer is a clue that a storm might be coming.

Anticipatory Set:
Have the students close their eyes. Tell them that we are all driving on a trip from Springville to Provo, and then up Provo canyon. As we are going up the canyon, we get higher and higher up into the mountains. Tell students to describe what they are seeing. Then ask students how their ears feel.

Strange question, right? Open your eyes. Have any of you been on a similar trip with your family in your car and felt you ears feeling differently? (ears popping)

Your ears popped because of the weight of the surrounding air. As you travel higher, there is less air pressing on your eardrums and it makes them hurt. You can yawn or swallow and get them to pop and it makes the pressure equal.

Input:
Remind students of the air experiments that we did in class. Ask them what they remember about our observations. Air pressure is the weight of air in our atmosphere pressing down on the earth. Air pressure is an important factor to weather.

Meteorologists measure air pressure with a weather tool called a barometer (show them the barometer). When the barometer changes, it means there has been a change in air

pressure…a change in how much the air is pressing down. Changes in pressure usually mean a change in weather.

Put a picture of a barometer on the overhead. Show them an example of how the barometer would change. Pass out the worksheet on reading a barometer and help them read each barometer. Tell students that we can measure air pressure in inches or centimeters.

If the barometer goes down, (air pressure decreases) this usually means STORMY WEATHER is coming. If the barometer moves up, (air pressure increases) this usually means CLEAR or FAIR WEATHER. If the barometer stays the same, the meteorologist would say that the barometer is steady and it usually means MORE OF THE SAME type of weather.

So, if the air pressure is falling and the temperature is 50 degrees and it is windy, what would happen? Probably rain or stormy weather. If the air pressure is rising and the temperature is 70 degrees, what weather would probably occur? Clear or fair weather.

Activity:
Have students make their own barometers. Show students how to make them first using the instruction sheet. Have students write down in their notebooks their prediction for the air pressure in the classroom. Then have them make their own barometer and then write the measurement in their notebooks. Have students put their jars somewhere in the room where they can stay up for a while. For the next few days, have students record the air pressure in their notebooks. The next time they measure it, if it is lower than that number, than the air pressure has dropped. If it is higher than that number, then the air pressure has risen. Once students have finished with their barometer, have them work on the barometer practice sheets.

Closure/Assessment:
Review with the students how the barometer works.

KEY TEST ITEMS:

1. Which instrument would be used to find out the air pressure?
    A. Barometer *
    B. Thermometer
    C. Anemometer
    D. Hygrometer
2. On Sunday, the air pressure drops, clouds form, and the temperature cools. What would be a reasonable forecast for Monday?
    A. sunny, warm, and fair skies
    B. sunny, cool, and fair skies
    C. cloudy, warm, and no rain
    D. cloudy, cool, and rain *

Air Pressure-Using a barometer

After you make your barometer, record the air pressure for the next few days.

My predictions and observations

I predict	
Over the next week I observed	
Day 1	
Day 2	
Day 3	
Day 4	
Day 5	
Day 6	

Describe what type of weather you would experience if there was extremely low air pressure.

_____

_____

Lesson 16: Wind + Cause/Effect lesson

Standard 2: Students will understand that the elements of weather can be observed, measured, and recorded to make predictions and determine simple weather patterns.
Objective 2: Interpret recorded weather data for simple patterns.
Objective 2c: Infer relationships between wind and weather change (e.g., windy days often precede changes in the weather; south winds in Utah often precede a cold front coming from the north).

Materials:
Cardstock copies of wind vane pattern
Pictures of different wind vanes
Straight pins for each student
Plastic straws for each student
Pencils for each student
Science notebooks
Tape

Purpose:
Students learn that moving air is called wind, and that knowing wind direction and speed can help meteorologists predict how the weather will change.

Anticipatory Set:
Have students observe the air pressure in their jars from a previous lesson and record their observations in their notebooks. What carries the sound of a snapping twig? How does a storm come racing through your town? What makes the smoke of a campfire angle as it rises? What makes a kite fly?

Input & CAUSE/EFFECT LESSON:
The earth is surrounded by a protective blanket of air, the atmosphere, which is constantly moving. Moving air is called WIND. Wind can cause relief or it can cause disaster. Invite students to discuss in their groups what ways wind can cause relief and when it can cause disasters. Have them record their answers on pg. 36 in their notebooks. (Wind can cool you off when you're hot, or fuel forest fires caused by summer lightning).

After students have had a chance to talk within their groups, have them construct a cause/effect sentence on their own about the effects of wind. Once students are finished, have them share within their groups, and then invite volunteers to share them with the class.

Learning about wind can help you know more about the weather. We learned that meteorologists are weather scientists that observe and forecast weather. Wind is one of the important weather conditions that they study. Knowing wind direction and wind speed can help them predict how to weather will change. A day with lots of wind from the south usually means that colder weather is coming.

How do you observe the direction of the wind? Do you notice leaves as they are blown in the fall? How important is knowing wind direction when flying a kite? WIND VANES have decorated barns, houses, and other public buildings for centuries. Show students pictures of different wind vanes. Ask students what other places they have seen wind vanes in. By observing wind vanes, meteorologists know a wind's direction and can predict how this moving air will change the weather conditions in an area.

Remind students that meteorologists use certain instruments to predict the weather: Weather balloons record wind speed in the upper atmosphere, an anemometer measures wind speed, a wind vane measures wind direction, and a Beaufort scale is a guide for measuring wind speed by observation.

Activity:
Students will make their own wind vanes.
Pass out a copy of the wind vane pattern to the students, a straw, pin, pencil, and tape.

Directions:
Cut out the wind vane patterns.
Cut a slit in both ends of the straw, about 2-3 cm (1 inch) from the ends.
Slide the pointer in one end of the straw and the tail fin in the other end, secure with tape.
Lay the arrow on your finger and find out where it balances, mark the point on the straw.
Push the pin through the straw at that point, and line up the pin, pointer, and the tail fin.
Push the pin into the eraser of the pencil.

Closure/Assessment:
Take the students outside and have them experiment with their wind vanes, recording in their notebooks what direction the wind is coming from based on where their wind vane in pointing to (If there is not wind, have students pair up and blow on each other's wind vanes).

KEY TEST ITEMS:
1. Temperature, humidity and wind speed are all measurements of air.
2. A calm day with little wind usually means the next day will have the same weather.
3. A day with lots of wind from the south usually means that colder weather is coming.
4. The more spins an anemometer makes, the higher the wind speed.

Wind vanes as a weather tool

With a partner, record a reason why wind vanes are an important weather tool.

Wind vanes are important because

_____

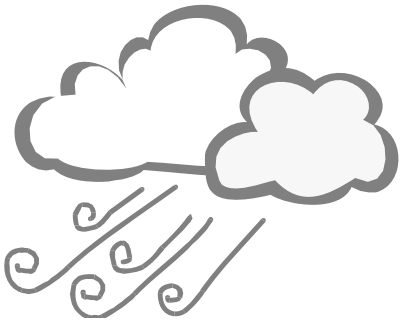
_____

Go outside to observe how your wind vane works. Record your observations below.

Draw a picture of what you observe	Describe what you observed

Wind effects

When does wind cause *RELIEF*?



_____

_____

_____

_____

When does wind cause *DISASTER*?

_____

_____

_____

_____

Now write a cause/effect sentence about the effects of wind. Don't forget to use a key word! Underline your key word.

Key

Wind effects

When can wind cause *RELIEF*?

A cool breeze feels good on a hot day

When you are sailing-you need wind

When you are playing sports outside in the heat

When does wind cause *DISASTER*?

It can spread forest fires

It can damage property

It can be too strong and will hurt people

Now write a cause/effect sentence about the effects of wind. Don't forget to use a key word! Underline your key word.

If there is too strong of a wind, then people can get hurt and property can be damaged.

Lesson 17: PART 1: Clouds

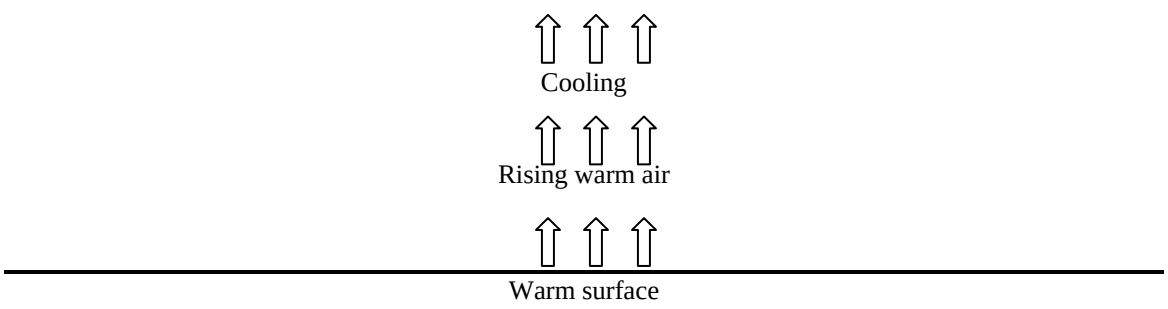
Standard 2: Students will understand that the elements of weather can be observed, measured, and recorded to make predictions and determine simple weather patterns.
Objective 1: Observe, measure, and record the basic elements of weather.
Objective 1b: Observe, measure, and record data on the basic elements of weather over a period of time (i.e., precipitation, air temperature, wind speed and direction, and air pressure).

Materials:
The Cloud Book, by Tomie dePaola
Jar
Warm water
Plastic bag with ice that fits over the jar opening
Sheet of black paper
Matches (for the teacher)
Science notebooks

Purpose:
Students learn that clouds are formed from rising warm air cooling, hitting dust, changing to water and the water creating a cloud.

Anticipatory Set:
Have students observe the air pressure in their jars from a previous lesson and record their observations in their notebooks. Ask students if they have ever sat and looked up at the clouds. Have a few students share some of the things they have seen. Have you ever wondered clouds got up there in the sky? Read, "The Cloud Book" by Tomie de Paola.

Input:
Have students write down in their notebooks their predictions (from what they remember from the water cycle) of how clouds form. Creating the diagram on the board, show students that Clouds form when warm air on the Earth's surface rises and then cools as it rises. As the air becomes cooler, the water vapor condenses on dust particles forming tiny water droplets. Those water droplets then grab on to dust and pollution in the sky and they all crowd together to form a cloud. The cloud is able to hang above us even though dozens of particles are all together because they are very tiny and light-weight. Have students check the prediction they wrote down. How close were they?



Activity:
Make a cloud in a jar. (Teacher Demonstration)
Tape the black paper around the back of the jar and fill the jar about 1/3 full with warm water. Have a bag of ice near the jar. Light a match and hold over the jar opening for a few seconds, then drop the match into the jar and cover the opening with the bag of ice. Observe inside the jar against the black paper to see a cloud form.

Write these words on the board:

Experiment	Real cloud formation
Warm water	Cool air
Ice	Dust particles
Match	Warm air

Have students turn to their neighbor and talk about what each part of the experiment represented in a real cloud formation. Then, match them up on the board. Have students Return to their notebooks and record their observations.

Closure/Assessment:
Review how a cloud is formed using the diagram. Have students think of other places clouds form (Mouths when it's cold outside, bathrooms when hot water is running for a period of time, etc.). Tell students to share with someone in their family when they get home how that cloud above their house formed.

KEY TEST ITEMS:
1. Warm air rises to meet cool air when a cloud forms.

Lesson 17: PART 2: Types of Clouds

Standard 2: Students will understand that the elements of weather can be observed, measured, and recorded to make predictions and determine simple weather patterns.
Objective 1: Observe, measure, and record the basic elements of weather.
Objective 1a: Identify basic cloud types: (i.e., cumulus, cirrus, stratus clouds).

Materials:
Pictures of the three types of clouds
Cloud chart homework handout for each student
Science Notebooks

Purpose:
Students will be able to identify the three types of clouds: Cirrus, Cumulus, and Stratus.

Anticipatory Set:
Read over the story below before the lesson and tell it to the students in your own words.

Godzilla Returns

"It is another one of those hot summer afternoons. Your mother has noticed that the tomato plants are a bit droopy and could use a drink. You just finished watching your favorite TV. show and could use a few brownie points so you volunteer to water the garden. With hose in hand, you set out on your task. It doesn't take too long to complete your work. As you walk to the faucet to turn off the water, you happen to look up. There it is. You can't believe your eyes. Godzilla is staring back at you. You run into the house to get the camera before Godzilla is gone. When you return, there is no Godzilla, but something new has taken its place. Godzilla has "morphed" into an elephant wearing a crown. The afternoon skies are filled with clouds in all shapes and sizes, and many of these clouds seem to tell a story."

Ask students if they have ever imagined the clouds to be certain things. Call on volunteers to explain the different things they saw in the clouds.

Input:
If you use a little imagination as you are looking up at clouds, you can watch the clouds change into many different things. Remember, we learned that clouds are really millions of droplets of water vapor that condense on dust in the air.

Native Americans, fur trappers, pioneers, and modern-day scientists have studied clouds to make weather predictions from what they observe. There are many different types of clouds and each type of cloud provides information about what is happening in the atmosphere. You can also learn to "read" the clouds to predict the weather.

There are three types of clouds. Have students discuss in their groups what they think/know the three types to be (Cirrus clouds, cumulus clouds, and stratus clouds).

Have students write these in their notebooks. Cirrus clouds are high, thin wispy clouds. (Show students the pictures as your describe them). These clouds could mean a warm front is approaching and the weather will turn stormy in a day or two. Cumulus clouds are the big, puffy, white clouds. They are the kind you like to watch on a pleasant summer day. Godzilla was this type of cloud. Cumulus clouds usually mean fair weather. Stratus clouds are lower. They are usually gray and often fill the sky completely. These "blanket" clouds could indicate rain or snow.

Activity:
Take the students outside (make sure they have their notebooks and a pencil). Have them observe the sky and sketch in their notebooks any clouds that they see, writing down the types of clouds they believe them to be and why.

As you return to class, discuss their findings.

Closure/Assessment:
Review the three types of clouds. Give students the cloud chart homework handout. For the next week, students are to go out several times at home to look at the sky. On the chart, they are to record the information of the types of clouds that they say.

KEY TEST ITEMS:
1. Students should know the name of the three types of clouds

2. What weather data would you need to collect to make an accurate forecast?
    -Air temperature, humidity, air pressure, wind, cloud cover, precipitation

3. What do cirrus clouds often predict?
    A. fair weather
    B. a storm *
    C. no change in weather
    D. low or no wind

Cloud formation & types of clouds

Think about what you learned in “The Water Cycle”. Write down what you remember about how clouds form.

_____

_____

_____

_____

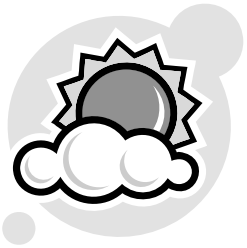
After observing the experiment, match the items of the experiment that represent items in a real cloud formation.

Experiment	Real cloud formation
Warm water	Cool air
Ice	Dust particles
Smoke	Warm air

Record your observations below

Draw a picture of what you observe	Describe what you observed

Types of clouds:



Observe the clouds outside. See if you can find each type of cloud, predicting which type of cloud each is. Then describe why you think they are the types of clouds you wrote down.

Draw a picture	Type of cloud	Describe this cloud

Name: _____

Cloud Chart

Date	Time	Cloud Type	Next Day Weather

Name: _____

Cloud Chart

Date	Time	Cloud Type	Next Day Weather

Lesson 18: Precipitation

Standard 2: Students will understand that the elements of weather can be observed, measured, and recorded to make predictions and determine simple weather patterns.
Objective 1: Observe, measure, and record the basic elements of weather.
Objective 1b: Observe, measure, and record data on the basic elements of weather over a period of time (i.e., precipitation, air temperature, wind speed and direction, and air pressure).

Materials:
Precipitation overhead & pictures of precipitation
One 2-liter bottle for each group
Small gravel (about 1-2 cups per group)
Water
Marker
Scissors
Science Notebooks

Purpose:
Students learn that precipitation is necessary for our survival, and that rain can be measured with a rain gauge.

Anticipatory Set:
Have students observe the air pressure in their jars from a previous lesson and record their observations in their notebooks. Ask students to think of what different kinds of precipitation that they know of, and have them record their answers in their notebooks. Afterwards, record all responses on the board, having students add anything on the board that is not on their list. Show students the precipitation overhead (Rain is a common form of precipitation in Utah during much of the year. With colder temperatures and different wind conditions, snow, sleet, or hail may result. All are examples of precipitation, water falling to the Earth).

Input:
Just as water is necessary for our survival and comfort, water was also necessary for the survival of the early settlers coming to Utah. They knew it was impossible to store and bring ALL the water that was needed for such a long journey. Rivers and springs helped to replenish low supplies, along with occasional rains and snowfall. Although storms would make their travel difficult, the water they received helped to sustain them on their trek west.

You know that meteorologists are weather scientists who measure and forecast conditions in the atmosphere. One of these conditions is precipitation. Precipitation is any form of water that condenses and falls to the Earth. Precipitation comes in many forms (Review the forms of precipitation).

How we dress, what activities we do, even where we live is determined by the forms and amounts of precipitation that fall. Meteorologists measure the types and amounts of precipitation. A RAIN GAUGE is the instrument they use.

Activity:
Students will construct a rain gauge and measure the amount 'rain'. Do a teacher demonstration of how to make one, and then have students make their own.

1. Have students cut a 2-liter plastic bottle in half using scissors.
2. Fill the base of the bottom half of the Liter bottle with about an inch of small gravel (The gravel will act as a weight and keep the rain gauge from tipping over).
3. Cover the gravel with water, and place a mark on the outside of the bottle with a permanent marker (This mark will be the beginning point). Each time the rain gauge is used, water may need to be added to see that the beginning water level matches the mark on the bottle.
4. Using a ruler, mark off measuring lines from the beginning point running up the bottle in even increments (cm. or inches).

(If it is raining that day, have students place their rain gauges outside, and as soon as the rain stops, take them outside to observe how much the water level has risen from the starting mark. Have students graph their rainfall over a week. If it is not raining, place the rain gauges in the classroom for a rainy day)

Closure/Assessment:
For practice in reading filled rain gauges, have several rain gauges ready for them to read. Have the class take the readings. If only a small amount of rain falls, but it is not measurable, it should be recorded as 'trace'.

KEY TEST ITEMS:
1. When does rain turn to snow? When…
    A. the clouds get closer to earth
    B. the clouds get darker
    C. air temperature gets colder *
    D. the wind blows

Precipitation and measuring it

List all of the types of precipitation that you can think of

_____ _____

_____ _____

_____ _____

Describe how precipitation forms

_____

_____

_____

_____

Measure the rain in the rain gauges and record the amount of rainfall. Remember that if the amount of rain is not measurable, it should be recorded as ‘trace’.

Rain gauge #1	Rain gauge #2	Rain gauge #3	Rain gauge #4	Rain gauge #5	Rain gauge #6
_____ cm	_____ cm	_____ cm	_____ cm	_____ cm	_____ cm
_____ in	_____ in	_____ in	_____ in	_____ in	_____ in

My rain gauge

If it is raining today, record the amount of rain that is collected in your rain gauge. If it is not raining, place your rain gauge outside and record the rainfall information below.

Day 1	Day 2	Day 3
_____ cm	_____ cm	_____ cm
_____ in	_____ in	_____ in

Lesson 19: Weather Fronts and Weather Charts + Cause/Effect lesson

Standard 2: Students will understand that the elements of weather can be observed, measured, and recorded to make predictions and determine simple weather patterns.
Objective 2: Interpret recorded weather data for simple patterns.
Objective 2a: Observe and record effects of air temperature on precipitation (e.g., below freezing results in snow, above freezing results in rain).
Objective 3: Evaluate weather predictions based upon observational data.
Objective 3d: Evaluate the accuracy of student and professional weather forecasts.

Materials:
Cold and warm front overhead
Weather front clippings from newspapers
Weather on the move worksheet for each student
U.S. map copy for each student (copied on both sides)
Science books-Unit D pg. 292
Science Notebooks
Crayons

Purpose:
Students learn that cold fronts and warm fronts affect weather usually by creating storms, and they are represented differently on weather maps. Students also learn how temperature and air pressure affect weather.

LESSON 1:

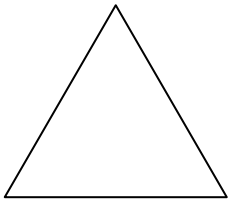
Anticipatory Set:
Have students observe the air pressure in their jars from a previous lesson and record their observations in their notebooks. Have you ever noticed how quickly the weather can change? Why? What things about the weather have we studied so far?

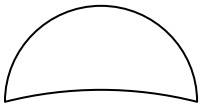
Input:
Read pg. 292 in the Science book together with the students (There are giant masses of air that move in the atmosphere over the Earth. These air masses form over different parts of the Earth and can be either warm or cold, dry or moist. When two different types of air masses meet, a front forms. When a front moves over an area, the weather changes).

CAUSE/EFFECT LESSON:
Have students open up in their notebooks to pg. 41. After reading and reviewing the paragraphs in their notebooks about fronts together, ask students if they know what type of text structure this author is using (Cause/effect). Ask them if they notice anything different about this text than other cause/effect texts (there are no key words).

Have students determine with their group the effects of the each front. Have them edit the text together and decide together where they could insert key words to make the paragraphs stand out as “cause and effect” text.

Share the paragraphs together as a class.
Meteorologists use special symbols on maps to show where weather fronts are located. A half circle shows where warm fronts are located. An triangle represents a cold front. A stationary front is represented by both symbols.


Cold front


Warm front

Fronts bring wind and bad weather. Cold fronts are worse than warm fronts in that cold fronts bring: blizzards and thunderstorms that move fast. Warm fronts bring stormy weather that lasts several days. A stationary front is made up of air masses that come in contact, but cannot push forward (made up of both symbols pushing each other).

A meteorologist can give us a more accurate forecast because they can use certain tools.

Activity:
Draw fronts on a map for students to observe how the fronts are recorded. Pass out newspaper clippings of weather fronts and a U.S. map for each student. Have students record and color two different examples (front and back of map).

Closure/Assessment:
Review the weather front symbols with students by asking volunteers to come up and draw examples on the overhead U.S. map.

KEY TEST ITEMS:
1. Students should be able to know that professional weather forecasts from meteorologists are more accurate because they are able to use tools.

LESSON 2:

Materials:
Examples of charts used to study weather (Newspaper, internet, weather charts)
Overhead of weather chart with questions
Science Notebooks

Purpose:
Students learn that temperature and air pressure affect weather

Anticipatory Set & Input:
Place different types of charts that are used to study the weather and have students observe them, discussing with their group some of the things that they notice on the charts (Newspaper, internet, weather charts).

Activity:
While showing the class a weather chart, walk around and discuss how to read it. Place the overhead up and ask students what the chart is telling us. Answer the questions with the students about what they observe on the chart.

Closure/Assessment:
Have students complete the second weather chart on their own, and then have them share with their neighbors.

KEY TEST ITEMS:
1. Students should be able to read a weather chart to see when it would most likely rain, and which month of the year a chart is probably representing.

Weather fronts

After reading the paragraphs on pg. 292 in your book and reviewing the paragraphs below, determine with your group the effects of the each front. Edit this text together and decide together where you could insert key words to make the paragraphs stand out as “cause and effect” text.

Cold fronts

Cold air mass moves under a warm air mass and it then moves upward and begins to cool. It condenses to water vapor and forms clouds. It may begin to rain and thunderstorms will often develop. The air temperature will become cooler as the cold air mass moves forward.

Warm fronts

Warm air moves over cold air and slides up over the cold air as it moves forward. The warm air moves slowly and so warm fronts bring steady rain instead of thunderstorms, followed by clear, warm weather as the warm air mass moves over the area.

Key

Weather fronts

After reading the paragraphs on pg. 292 in your book and reviewing the paragraphs below, determine with your group the effects of the each front. Edit this text together and decide together where you could insert key words to make the paragraphs stand out as “cause and effect” text.

Cold fronts

When cold air mass moves under a warm air mass, it moves upward and begins to cool. It condenses to water vapor and as a result, forms clouds. This may cause rain and thunderstorms to develop, and the air temperature will become cooler as the cold air mass moves forward.

Warm fronts

As warm air moves over cold air, it slides up over the cold air as it moves forward. The warm air moves slowly and as a result, the warm fronts bring steady rain instead of thunderstorms, followed by clear, warm weather as the warm air mass moves over the area.

Lesson 20: Bill Nye on Water Cycle/Weather--Review

Materials:
Bill Nye video "Weather"
Science "Swat" for weather
Science Notebooks

Purpose:
Students review the weather unit

Activity:
Have students observe the air pressure in their jars from a previous lesson and record their final observations in their notebooks, discussing their results together and what they have noticed about any changes in the air pressure over time. Watch the "Bill Nye" movie on weather. Have students record in their notebooks the three most important things that were discussed in the movie. Have students pay special attention to concepts in the movie that relate to what we have learned in class (This is a review of the concepts).

Closure/Assessment:
Have students get in groups and discuss the three most important things that they learned from the movie that relate to our class lessons.

Play "Weather SWAT" with the class. Split them into two teams. Have one person from each team go to the back of the room with a fly swatter. Read a definition of a weather term, and when you say "Go!" the student's "power walk" to the front of the room and SWAT the correct word that matches the definition. Take score and play the game until all the words have been swatted.

TOP THREE LIST: Weather

As you watch the movie about Weather, write down three important things that you learned.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Weather

seasonal

accurate

air pressure

air temperature

meteorologist

forecast

cumulus

freezing

COMPONENT

stratus

precipitation

thermometer

rain gauge

severe

CIRRUS

barometer

wind speed

PHENOMENON

Lesson 21: Test

Materials:
Weather Test for each student
Science Words word search for each student

Pass out the test and have students take it. When they are finished, give them a word search to work on until everyone is done. Correct the test as a class.

Name_____

Weather Test

True *or* False

Circle the answer you think is correct.

1. True or False — A windy day usually means the next day will be calm.

2. True or False — Weather is uncontrollable and we cannot measure it.

3. True or False — The most important goal of weather forecasting is to save property and lives.

4. True or False — Air cannot be measured.

5. True or False — Rain turns to snow when the air temperature gets colder.

Multiple Choice

Choose the answer that best fits each question.

6. Study the Utah County weather data chart below and answer the question.

	Monday	Tuesday	Wednesday	Thursday	Friday
Temperature	93 F	87 F	82 F	80 F	85 F
Air Pressure	30.8 in	30.2 in	29.5 in	28.9 in	30.1 in
Wind Speed	5 mph	15 mph	25 mph	10 mph	5 mph
Cloud Cover	Clear	Partly cloudy	Cloudy	Clear	Clear

The month of the year that is probably represented here is

a. March
b. November
c. January
d. July

7. In the chart of data below, _____ is being recorded.

Day 1	Day 2	Day 3	Day 4	Day 5
67 F	71 F	69 F	70 F	72 F

a. temperature
b. air speed
c. humidity
d. air pressure

8. The most probable weather data for Salt Lake City in January is ____.

a. 95 F temperature, 1 mph wind speed, sunny
b. 20 F temperature, 10 mph wind speed, snow
c. 48 F temperature, 50 mph wind speed, rain
d. 65 F temperature, 15 mph wind speed, rain

9. Aunt Shari says that if you hear frogs croaking really loud, it will rain the next day. This forecast is different than a meteorologist's because _____.

a. she is not using scientific evidence or tools
b. she is probably correct most of the time
c. she doesn't care what happens on Monday
d. she isn't interested in accuracy

10. Which of the following is the most accurate way to predict the weather?
a. interview a person with achy joints
b. count ice rings around the moon
c. observe animal behavior
d. observe changes in barometric pressure

11. The weather forecaster says that a thunderstorm is approaching your town. What kind of weather is coming?
a. cirrus clouds, lower temperatures, and rain
b. dark cumulus clouds, low temperatures, and rain
c. cirrus clouds, higher temperatures, and rain or snow
d. stratus clouds, no temperature change, and no rain

Fill in the blank

Choose from below the answers that fit in each blank

thermometer rain gauge meteorologist barometer air

12. Temperature, humidity, and wind speed are all measurements of _____.

13. An instrument that is used to measure air pressure is called a _____.

14. Rainfall can be measured by using a _____.

15. A meteorologist measures temperature by using a _____.

16. A _____ is a scientist that studies weather.

Name_____

Types of Clouds

Draw a picture and describe what you know about each type of cloud:

	Draw a picture	Describe what you know
Cirrus Clouds	17.	18.
Cumulus Clouds	19.	20.
Stratus Clouds	21.	22.

Name_____

Weather Test—Part 2

1. List 6 key words you might find while reading a cause/effect text.

   1._____ 2._____ 3._____

   4._____ 5._____ 6._____

2. Determine the cause and the effect(s) of this sentence.

A tornado strikes your town, and as a result, it severely damaged property and many people were injured.

Cause:_____

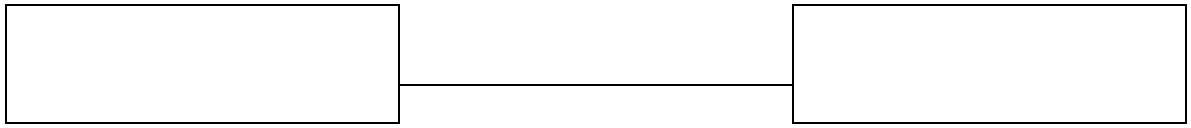
_____

Effect(s):_____

_____

Underline the key word in the sentence, and then map it out below.

2. Sometimes cumulous clouds can grow into huge clouds that cause thunderstorms.



Writing cause *and* effect sentences

3. Write a cause/effect sentence about a severe thunderstorm. Underline the key word(s).

_____

_____

4. While reading a thermometer, you notice that the temperature has fallen throughout the day. What might be the <u>cause</u> of this? Write a cause and effect sentence. Underline the key word (s).

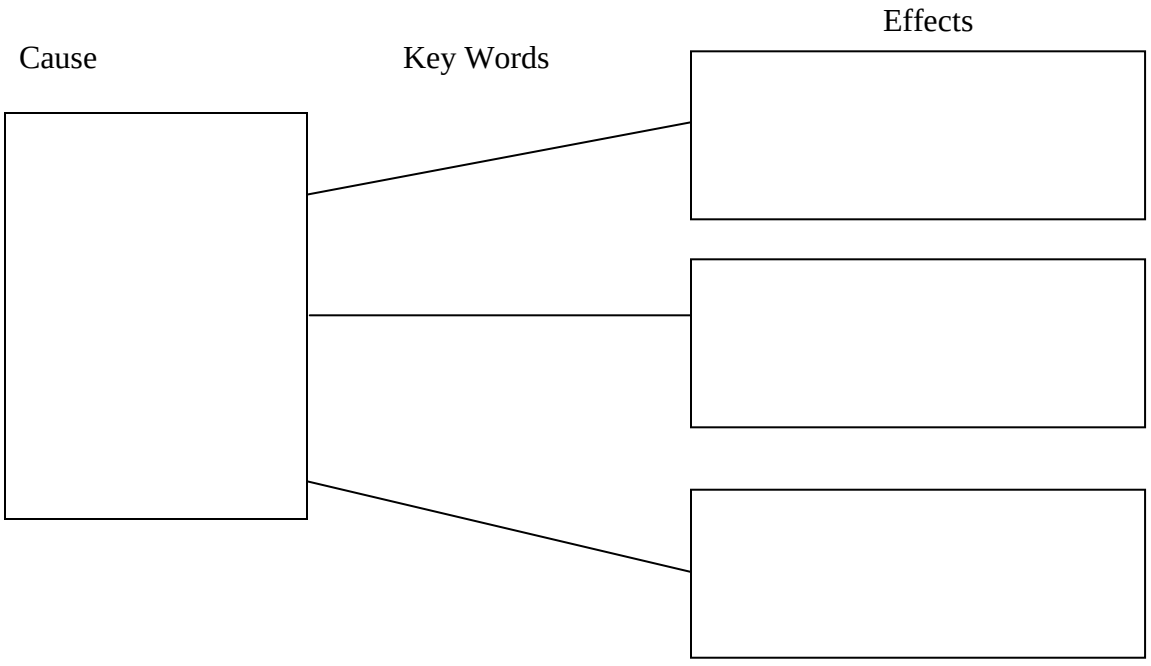
_____

_____

_____

_____

5. Read the paragraph and then map it out below.



KEY

Weather Test

True *or* False

Circle the answer you think is correct.

1. True or FALSE — A windy day usually means the next day will be calm.

2. True or FALSE — Weather is uncontrollable and we cannot measure it.

3. TRUE or False — The most important goal of weather forecasting is to save property and lives.

4. True or FALSE — Air cannot be measured.

5. TRUE or False — Rain turns to snow when the air temperature gets colder.

Multiple Choice

Choose the answer that best fits each question.

6. Study the Utah County weather data chart below and answer the question.

	Monday	Tuesday	Wednesday	Thursday	Friday
Temperature	93 F	87 F	82 F	80 F	85 F
Air Pressure	30.8 in	30.2 in	29.5 in	28.9 in	30.1 in
Wind Speed	5 mph	15 mph	25 mph	10 mph	5 mph
Cloud Cover	Clear	Partly cloudy	Cloudy	Clear	Clear

The month of the year that is probably represented here is

a. March
b. November
c. January
d. JULY

7. In the chart of data below, _____ is being recorded.

Day 1	Day 2	Day 3	Day 4	Day 5
67 F	71 F	69 F	70 F	72 F

a. TEMPERATURE
b. air speed
c. humidity
d. air pressure

8. The most probable weather data for Salt Lake City in January is ____.

a. 95 F temperature, 1 mph wind speed, sunny
b. 20 F TEMPERATURE, 10 MPH WIND SPEED, SNOW
c. 48 F temperature, 50 mph wind speed, rain
d. 65 F temperature, 15 mph wind speed, rain

9. Aunt Shari says that if you hear frogs croaking really loud, it will rain the next day. This forecast is different than a meteorologist's because _____.

a. SHE IS NOT USING SCIENTIFIC EVIDENCE OR TOOLS
b. she is probably correct most of the time
c. she doesn't care what happens on Monday
d. she isn't interested in accuracy

10. Which of the following is the most accurate way to predict the weather?
a. interview a person with achy joints
b. count ice rings around the moon
c. observe animal behavior
d. OBSERVE CHANGES IN BAROMETRIC PRESSURE

11. The weather forecaster says that a thunderstorm is approaching your town. What kind of weather is coming?
a. cirrus clouds, lower temperatures, and rain
b. DARK CUMULUS CLOUDS, LOW TEMPERATURES, AND RAIN
c. cirrus clouds, higher temperatures, and rain or snow
d. stratus clouds, no temperature change, and no rain

Fill in the blank

Choose from below the answers that fit in each blank

thermometer rain gauge meteorologist barometer air

12. Temperature, humidity, and wind speed are all measurements of AIR.

13. An instrument that is used to measure air pressure is called a BAROMETER.

14. Rainfall can be measured by using a RAIN GAUGE.

15. A meteorologist measures temperature by using a THERMOMETER.

16. A METEOROLOGIST is a scientist that studies weather.

KEY

Types of Clouds

Draw a picture and describe what you know about each type of cloud:

	Draw a picture	Describe what you know
Cirrus Clouds	17.	18. Cirrus clouds are high, thin wispy clouds. Usually indicate cool, fair weather. These clouds could mean a warm front is approaching and the weather will turn stormy in a day or two.
Cumulus Clouds	19.	20. Cumulus clouds are the big, puffy, white clouds. They are the kind you like to watch on a pleasant summer day. Cumulus clouds usually mean fair, clear, warm weather.
Stratus Clouds	21.	22. Stratus clouds are lower and occur along warm fronts. They are usually gray and often fill the sky completely. These “blanket” clouds could indicate rain or snow.

KEY

Name_____

Weather Test—Part 2

1. List 6 key words you might find while reading a cause/effect text.

because	this led to	as a result
then	since	and so
reason for	explains why	result
caused	if…then	

2. Determine the cause and the effect(s) of this sentence.

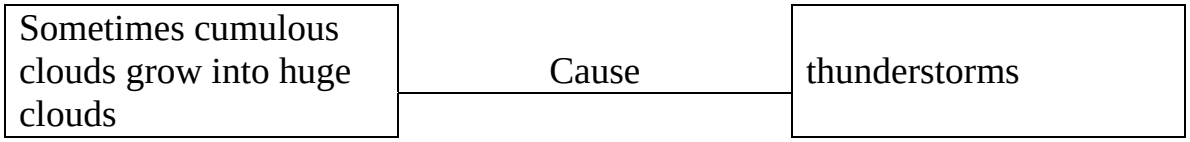
A hurricane strikes your town, and as a result, it severely damaged property and caused flooding.

Cause: A hurricane strikes your town.

Effect(s): It severely damaged property and caused flooding.

Underline the key word in the sentence, and then map it out below.

3. Sometimes cumulous clouds can grow into huge clouds that cause thunderstorms.



Writing cause *and* effect sentences

4. Write a cause/effect sentence about a severe thunderstorm. Underline the key word(s).

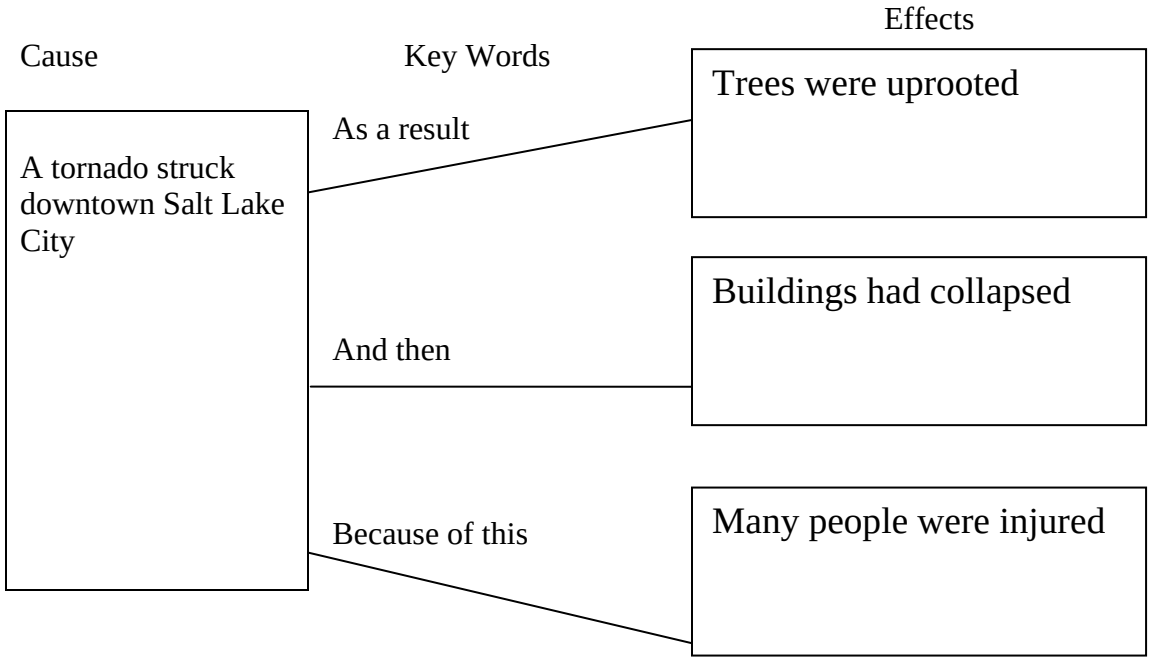
A terrible thunderstorm hit our city. As a result, trees were uprooted, and then houses were damaged, which led to people being injured.

5. While reading a thermometer, you notice that the temperature has fallen throughout the day. What might be the <u>cause</u> of this? Write a cause and effect sentence. Underline your key word.

The temperature on a thermometer falling <u>is a result of</u> a cold front coming in.

6. Read the paragraph and then map it out below.

A class of fourth grade students in West Jordan, Utah went outdoors to observe the weather for an experiment they were doing in Science. The air temperature was 70˚ F (21˚ Celsius) under very windy conditions. Looking to the west, the students noticed very dark clouds. The students recorded their observations in their science notebooks. An hour later, the students were shocked to hear from their teacher that a thunderstorm and a tornado had struck downtown Salt Lake City. As a result of the tornado, many trees were uprooted, buildings had collapsed, and because of this, many people were injured.



Name: _____

Teacher: _____

My science notebook about:

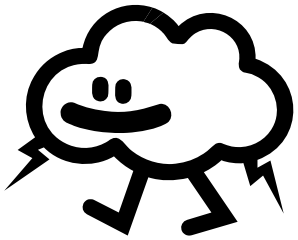
_____

What do you know?

What do you know about weather?

What is weather?

Write down as many words you can that have to do with weather



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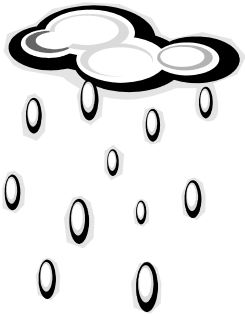

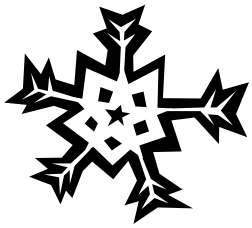

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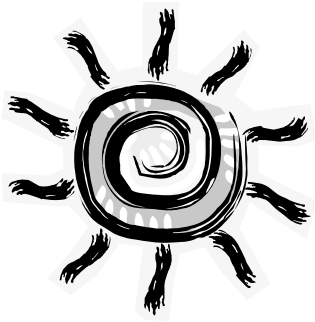
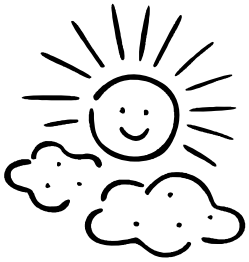


The Sun and our Atmosphere



Write down as many reasons as you can think of about why the sun is helpful to us on earth.

The sun is helpful because

_____

_____

_____

_____

_____

Record the temperature of soil and water so that we can determine which will cool down faster.

Soil: _____ Water: _____

My predictions and observations

I predict	I observed

The earth is covered with a huge layer of air that is always moving.
There are 3 layers: Troposphere, Stratosphere, and the upper atmosphere.

Draw a picture of the atmosphere below

The Atmosphere

Write a sentence describing each layer in the atmosphere.

The Upper Atmosphere…

_____

_____

The Troposphere …

_____

_____

The Stratosphere…

_____

_____

What is a Meteorologist?

Lights, camera, action! That is what most people think of when they think of TV. Most people think that the only thing a TV weathercaster or _____ does is stand in front of the camera and point to weather maps. But this is one of the easier things that a meteorologist does. A _____ _____ on TV usually only takes a few minutes. However, getting ready for the broadcast may take hours since meteorologists have to gather information about the weather before they can tell us the _____.

Meteorologists use _____ and _____ data to assist them in predicting both short term and long-term weather forecasts. You have probably noticed radar and satellite photos on the local news during the weather segment. Scientists also fill large _____ with helium. These balloons are equipped with special _____ _____. The balloons are sent high into the _____ where information can be gathered to help meteorologists make accurate weather forecasts.

Being a meteorologist is an important job. One of the most important goals of weather forecasting is to _____ _____ and _____. If a hurricane is coming, a meteorologist can warn people in advance. If a large snowstorm is coming, they can give people advance notice so that they can be prepared. Recorded weather information is very important to all people. _____ use the information to know when to plant crops. _____know when they can plant flowerbeds based on the weather information

People plan _____ around weather information. _____ use weather data to help plan rocket launches and to see if climate is changing. A lot of people depend on the information that meteorologists give us.

Many people believe that you can't see into the future. Perhaps they are thinking about magic and crystal balls. Good meteorologists do indeed predict the future, however, you probably know that sometimes they are _____. It might even cause you some grief when your plans have to change because of an incorrect forecast. Let's say that you have planned a trip to the zoo with your family. You watch the weather forecast and it says it will be clear weather. But when you wake up the next morning, it is raining instead. The meteorologist was probably wrong because there are so many _____ _____ that can change very quickly. More technology and better weather tools have lead to more accurate forecasts, however, because there are so many things that can affect the atmosphere and change weather patterns, weather forecasting will probably _____ be _____ % _____. Even though predicting the weather is never completely correct, you might be surprised at how good you can get at predicting tomorrow's weather!

So, the next time your Uncle Rob says that if the cat sleeps all day, it will rain the next day…will you think his prediction is accurate? Hopefully not. His forecast did not use scientific _____ or tools. When you want accurate and useful weather forecasts, turn on your local news and see what the meteorologist has to say! And, who knows, maybe someday you'll be that meteorologist!

With a partner, use the missing words you filled in and create a small summary to describe a meteorologist.

A meteorologist…

_____

_____

_____

_____

_____

_____

_____

_____

_____

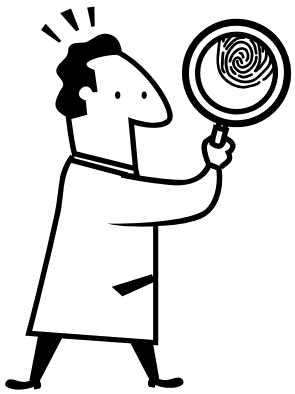
_____

_____

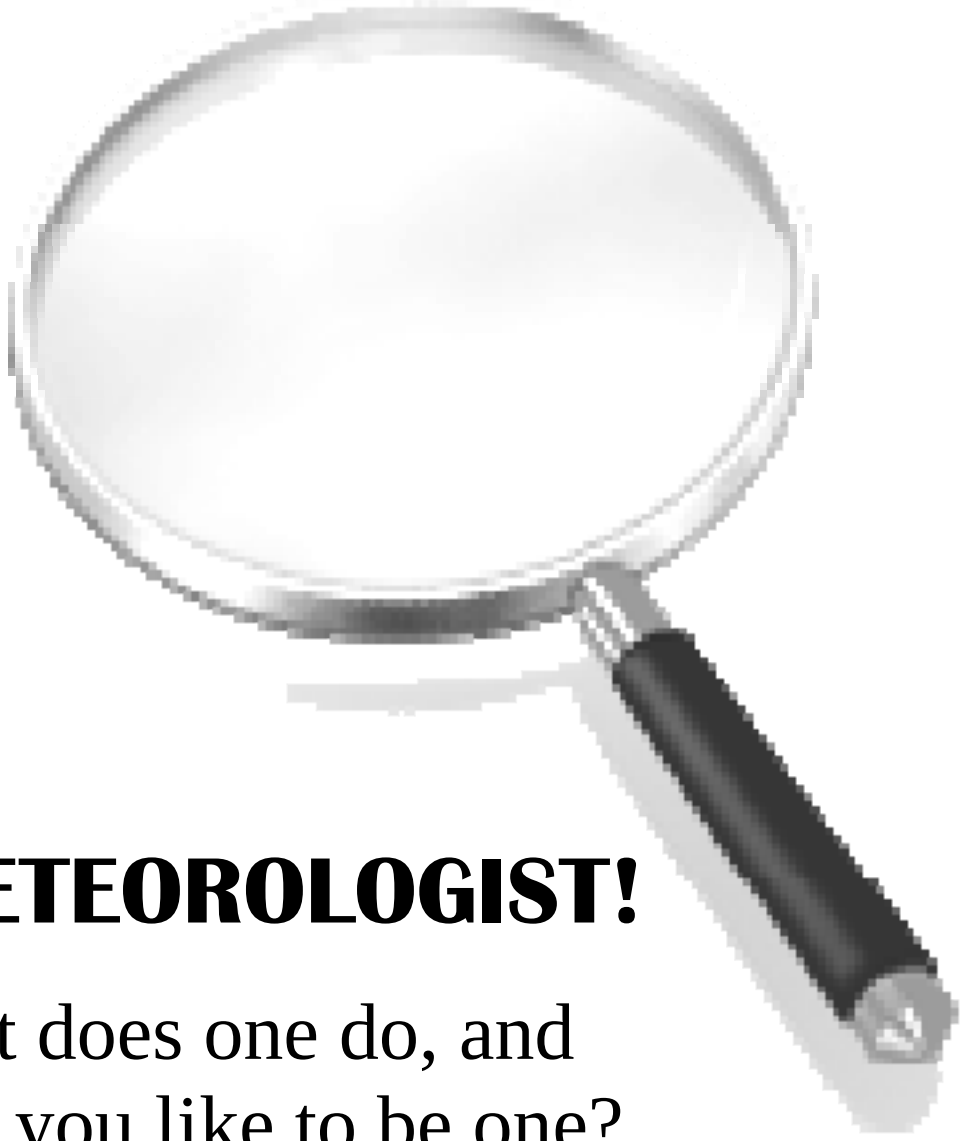
_____

_____

_____



A closer look at....



...a METEOROLOGIST!

What does one do, and would you like to be one?

Answer these questions in the magnifying glass

Experimenting with Air

How do we know that there is air around us even when we can't see it?

Does air weigh anything?

Does air take up space?

Experiments with Air

#1 _____

My predictions and observations

I predict	I observed

#2 _____

My predictions and observations

I predict	I observed

#3 _____

My predictions and observations

I predict	I observed

#4 _____

My predictions and observations

I predict	I observed

#5 _____

My predictions and observations

I predict	I observed

Write about what you learned today about air.
Today I learned that…

_____

_____

_____

_____

Using a Thermometer

As you are experimenting with thermometers, record your observations.

I predict the temperature outside to be: _____

The actual temperature was: _____

Draw a picture of what you observe	Describe what you observed

My predictions and observations

I predict	I observed

Matching Temperatures

1. Record the temperature on each thermometer.

#	Fahrenheit
1	
2	
3	
4	
5	

#	Celsius
1	
2	
3	
4	
5	

2. Now use the thermometer with both Farenheit and Celsius on it. For each Fahrenheit temperature, find its match in Celsius

Fahrenheit	Celsius

Temperature Scenarios

While reading a thermometer, you notice that the temperature has fallen throughout the day. What might be the cause of this?

Discuss with your group the cause for the temperature on the thermometer to fall, then create one cause/effect statement below. Make sure you are using key words! Underline the key words that you use.

_____

_____

_____

_____

Now create your own cause/effect statement that is different from the one above without the help of your group. Don't forget to underline your key words.

_____

_____

_____

_____

Weather in Utah

Discuss the different seasons with your team members below and fill in the blanks.

Summer -Clothes: -Average temp: -Common precipitation: -Months:	**Fall** -Clothes: -Average temp: -Common precipitation: -Months:
Winter -Clothes: -Average temp: -Common precipitation: -Months:	**Spring** -Clothes: -Average temp: -Common precipitation: -Months:

Using the information above, choose one season and write a summary of the types of clothes usually worn, the average temperature, the common precipitation, and the months of the season.

_____

_____

_____

_____

_____

Precipitation Review

With your group, match the clue on the left to the term on the right. Write the letter in the blank.

___ frozen rain	A. rain
___ liquid water	B. snow
___ round pieces of ice	C. sleet
___ ice crystals	D. hail

Complete the table below by writing a cause/effect sentence. Don't forget to include a key word! Underline your key words.

Cause	Effect	Sentence
Water droplets become heavy in a cloud	Rain	
Falling rain passes through a layer of freezing air	Sleet	
Water vapor in clouds turns directly to ice	Snow	

Severe weather phenomena!

List all of the severe weather phenomena that you can think of

_____ _____

_____ _____

Information	What this looks like
1. 2. 3. 4.	
1. 2. 3. 4.	
1. 2. 3. 4.	

Severe Weather-Causes and Effects

Read the selection below. Circle the key words that you notice, and then identify the cause and effect. Remember that some causes have many effects. After you decide on the cause and effect, map it out below.

A destructive windstorm called a tornado carries large objects into the air. As a result, these objects then fall onto things like houses, trees, and roads, causing destruction. Tornadoes are dangerous, and we must be in a safe place while a tornado is near.

Now map it out:

Air Pressure-Using a barometer

After you make your barometer, record the air pressure for the next few days.

My predictions and observations

I predict	
Over the next week I observed	
Day 1	
Day 2	
Day 3	
Day 4	
Day 5	
Day 6	

Describe what type of weather you would experience if there was extremely low air pressure.

_____

_____

Wind vanes as a weather tool

With a partner, record a reason why wind vanes are an important weather tool.

Wind vanes are important because

_____

_____

Go outside to observe how your wind vane works. Record your observations below.

Draw a picture of what you observe	Describe what you observed

Wind effects

When does wind cause *RELIEF*?

_____

_____

_____

_____

When does wind cause *DISASTER*?

_____

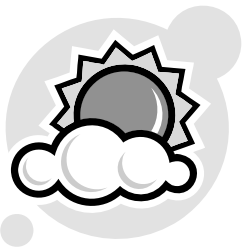
_____

_____

_____

Now write a cause/effect sentence about the effects of wind. Don't forget to use a key word! Underline your key word.

Cloud formation & types of clouds



Think about what you learned in “The Water Cycle”. Write down what you remember about how clouds form.

_____

_____

_____

_____

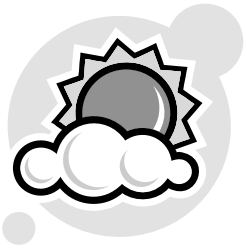
After observing the experiment, match the items of the experiment that represent items in a real cloud formation.

Experiment	Real cloud formation
Warm water	Cool air
Ice	Dust particles
Smoke	Warm air

Record your observations below

Draw a picture of what you observe	Describe what you observed

Types of clouds:



Observe the clouds outside. See if you can find each type of cloud, predicting which type of cloud each is. Then describe why you think they are the types of clouds you wrote down.

Draw a picture	Type of cloud	Describe this cloud

Precipitation and measuring it

List all of the types of precipitation that you can think of

_____ _____

_____ _____

_____ _____

Describe how precipitation forms

_____

_____

_____

_____

Measure the rain in the rain gauges and record the amount of rainfall. Remember that if the amount of rain is not measurable, it should be recorded as ‘trace’.

Rain gauge #1	Rain gauge #2	Rain gauge #3	Rain gauge #4	Rain gauge #5	Rain gauge #6
_____ cm	_____ cm	_____ cm	_____ cm	_____ cm	_____ cm
_____ in	_____ in	_____ in	_____ in	_____ in	_____ in

My rain gauge

If it is raining today, record the amount of rain that is collected in your rain gauge. If it is not raining, place your rain gauge outside and record the rainfall information below.

Day 1	Day 2	Day 3
_____ cm	_____ cm	_____ cm
_____ in	_____ in	_____ in

Weather fronts

After reading the paragraphs on pg. 292 in your book and reviewing the paragraphs below, determine with your group the effects of the each front. Edit this text together and decide together where you could insert key words to make the paragraphs stand out as “cause and effect” text.

Cold fronts

Cold air mass moves under a warm air mass and it then moves upward and begins to cool. It condenses to water vapor and forms clouds. It may begin to rain and thunderstorms will often develop. The air temperature will become cooler as the cold air mass moves forward.

Warm fronts

Warm air moves over cold air and slides up over the cold air as it moves forward. The warm air moves slowly and so warm fronts bring steady rain instead of thunderstorms, followed by clear, warm weather as the warm air mass moves over the area.

TOP THREE LIST: Weather

As you watch the movie about Weather, write down three important things that you learned.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____