

EFFECTS OF TEACHER-DIRECTED AND STUDENT-INTERACTIVE
SUMMARIZATION INSTRUCTION ON READING COMPREHENSION AND
WRITTEN SUMMARIZATION OF KOREAN FOURTH GRADERS

BY

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DISSERTATION

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Abstract

The purpose of this study was to investigate how Korean fourth graders' performance on reading comprehension and written summarization changes as a function of instruction in summarization across test times. Seventy five Korean fourth graders from three classes were randomly assigned to the collaborative summarization, direct instruction, and control groups. During six sessions of 20 min instruction, the experimental students received instruction in summarization via two instructional approaches: collaborative summarization and direct instruction. The collaborative summarization model was developed as an alternative to direct instruction to incorporate scaffolding and active social interaction. Reading comprehension was assessed using three sentence verification tests. Summarization was examined in terms of identifying main ideas and including extraneous information. Writing quality was a combined rating of focus, support, and organization indices.

The collaborative summarization group's performance was significantly improved on identification of main ideas and writing quality in comparison to the control group, but the benefit of collaborative summarization was not reflected in reading comprehension. All three groups tended to produce shorter summaries on posttest and follow-up test than on the pretest, which led to inclusion of significantly fewer extraneous idea units on posttest and follow-up test than on the pretest. The two students at risk for reading difficulties benefited from receiving summarization instruction on reading comprehension, identification of main ideas, and writing quality, but this benefit was not durable. Collaborative summarization needs to be further refined to establish overarching instructional procedures that incorporate scaffolding and peer interaction.

*Greatest glory to God, my solid Rock,
who designed and will complete his wonderful plan for me*

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Chapter I

Rationale

Reading is integral for academic achievement during schooling and is critical for successful employment (National Reading Panel [NRP], 2000). The essential goal of reading is to comprehend a variety of materials written for diverse purposes. Reading comprehension is defined as “the process of simultaneously extracting and constructing meaning through interaction and involvement with written language” (NRP, p. 11).

In the definition, three dimensions of reading comprehension are involved: reader, text, and activity (NRP, 2000). *Reader* refers to readers’ cognitive abilities, motivation, and knowledge of vocabulary, domains, and comprehension skills. *Text* involves genre, reading level, and content presented in the text. The more familiar a text is to a reader’s topical knowledge and experience with genre, the better readers will understand the text. *Activity* includes purposes for reading, operations employed to process the text, and consequences of reading. Prior to reading, readers have one or more purposes, which are internally generated or externally imposed. During reading, readers use cognitive operations to process the text. As a result, readers are expected to acquire vocabulary and domain knowledge, critical thinking, and new ideas.

Currently, the importance of text genre, as a feature of text dimension, has received attention in relation to reading comprehension. With a rapid increase of informational texts at third and fourth grades in comparison to primary grades, students are more likely to encounter reading difficulties (Chall, 1983; Duke, 2000; Jeong, Gaffney, & Choi, in press). Gersten, Fuchs, Williams, and Baker (2001) argued that

students with learning disabilities (LD) have limited understanding of different structures

Heading Levels

This literacy achievement gap was reflected in Annual Reports to Congress from 1997-1998 through the 2001-2002 school years (Office of Special Education and Rehabilitative Services, 1999, 2000, 2001, 2002, 2003). Approximately 52% of students with LD were identified at grades 3 and 4. According to the 2007 reports of the annual reading assessment by the National Center for Education Statistics (NCES), the proportion of fourth graders whose reading scores were below the basic reading level is 33% (NCES, 2007). Performance below the basic reading level means that one third of fourth graders cannot read well enough to effectively complete grade-level work.

Leach, Scarborough, and Rescorla (2003) examined the types of reading difficulties that students identified with LD at grades K-3 and grades 4-5 exhibit. They revealed that the percentage of students struggling with word recognition decreased from 95% at grades K-3 to 67% at grades 4-5 but students who exhibited difficulties with comprehension increased from 52% to 64%. Based on the Annual Reports, NCES, and Leach et al., students are more likely to have difficulties with reading comprehension around fourth grade and these reading difficulties correspond to the increase of informational text. Saenz and Fuchs (2002) found that high school students' performance was significantly better in reading fluency and comprehension with narrative than expository text.

In Korea, informational text first appears in first grade textbooks such as Korean Language, Right Life, and Wise Life. Right Life combines morality and social studies. Wise Life corresponds to science. Most information texts are presented in Wise Life at

first grade, although Korean Language and Right Life contain a few informational passages. The amount of informational text, however, remarkably increases as social studies is taught as an individual subject beginning in third grade. Social studies deals with a broad range of knowledge and information regarding economy, geography, history, and politics (Kim & Kim, 2000). Accordingly, students encounter many technical words and unfamiliar information related to each area. Thus, students struggling with reading are likely to experience overload on understanding social studies text. Korean elementary students report that social studies is their most difficult subject (Cited in Min & Kim, 2002).

According to 2007 educational statistics reported by the Korea Ministry of Education, Science, and Technology, approximately 0.8% (65,940) of students (8,299,228) enrolled in schools receive special education services and 10.6 % (6,982) of them are identified with learning disabilities (Ministry of Education, Science, & Technology, n.d., 2008). Since 2002, the Korea Ministry of Education, Science, and Technology has conducted annual nationwide assessment to ensure that every third grader reaches basic scholastic abilities in reading, writing, and math. On average, 3.14 % of third graders performed below basic reading ability from 2002 to 2005. About 87% of the students that did not attain the basic level had difficulties with reading comprehension and 20% and 40% of them struggled with decoding and vocabulary knowledge, respectively (Korea Institute of Curriculum and Evaluation [KICE], 2004).

Korean students ranked in the first place in the reading test of Programme for International Student Assessment (PISA) 2006, which was conducted by the Organisation for Economic Cooperation and Development (OECD) (KICE, 2007). The reading test

assessed abilities to use, understand, and reflect on written information for various purposes and test items were developed considering three dimensions: structure of the text, reading process, and situation of reading. Particularly, structure of the text is divided into continuous and non-continuous texts. Continuous texts are composed of narration, exposition, description, argumentation, instruction, and document. Non-continuous texts included charts, graphs, diagrams, tables, maps, and so on. Although PISA did not specify the genres of texts, the majority of texts seem to be informational.

Based on the 2003 nationwide assessment of basic scholastic abilities and PISA 2006, the proportion of Korean students struggling with reading is low but the majority who do exhibit difficulties have problems with reading comprehension. As a consequence, reading comprehension should be the main focus of literacy education to prevent students from lagging behind in school. Since no description of classroom reading instruction is available in Korea, one cannot assume how teachers deal with reading comprehension of informational texts with students at third grade and above. In the U.S., Durkin (1978-79) conducted classroom observations of reading and social studies at grades 3-6 and found that instruction in reading comprehension is rarely provided in classrooms.

In comparison to the lack of comprehension instruction in classrooms, the effectiveness of various comprehension skills have been studied. Summarization is a method that has been effective in improving comprehension of informational texts (Armbruster, Anderson, & Ostertag, 1987; Bean & Steenwyk, 1984; Cordero-Ponce, 2000; Day, 1986; Friend, 2001; Malone & Mastropieri, 1991; Rogevich & Perin, 2008; Rosenshine, 1983). Summarization is defined as finding or extracting main ideas and

supporting elements, and integrating the ideas and elements into a coherent form (Brown & Day, 1983). Brown and Day identified basic rules of summarization, which are cognitive operations that take place while writing a summary. The rules are deletion of unnecessary and redundant information, superordination of lists, selection of a topic sentence, and invention of a topic sentence.

In an attempt to extract commonality from different terminology that researchers use to describe cognitive operations involved in summarization, Hidi and Anderson (1986) reduced cognitive operations into the selection process, condensation of information, and recognition that a summary should be concise and needs complex integration and transformation of the original text. In the process of selection, in which the importance of text segments is evaluated relative to the whole passage, segments to be judged important are selected but those to be evaluated less important are deleted. In the condensation process, details are replaced with more general concepts. Major topics are concisely represented through complex integration and combination.

Summarization is often confused with either identification of main ideas or retelling. Finding main ideas is an important element of summarization but summarizers must organize main ideas in a hierarchical order based on importance of idea units (Thistlethwaite, 1991). Finding main ideas does not necessarily lead to making a quality summary. Retelling is a task wherein readers reproduce, either orally or in writing, a holistic understanding of what they read. While retelling, readers may become aware of text organization and the relationship among pieces of information they recall (Bromley, 1998). Although texts are reconstructed in retelling and summarization, summarization requires higher cognitive operations than retelling. Summarization requires the reader to

determine what should be included or excluded and integrate idea units in a coherent format, whereas the intent of retelling is to reproduce whatever readers can recall.

The effectiveness of summarization has been assessed through comprehension tests such as researcher-developed multiple choice tests (Gajria & Salvia, 1992; Hare & Borchardt, 1984; Nelson & Smith, 1992; Rogevich & Perin, 2008; Wood, Winne, & Carney, 1995) and recall assessments (Armbruster et al., 1987; Cordero-Ponce, 2000; Rinehart, Stahl, & Erickson, 1986; Wood et al., 1995). Instruction in summarization was also found to enhance identification of important information, application of diverse summarization rules, and quality of a written summary (Armbruster et al., 1987; Cordero-Ponce, 2000; Day, 1986; Friend, 2001; Gajria & Salvia, 1992; Hare & Borchardt, 1984; Nelson & Smith, 1992; Rogevich & Perin, 2008; Wood et al., 1995). Except for Gajria and Salvia (1992)'s study, in which students produced oral summaries of expository text, written summaries were evaluated in the other summarization studies.

Summarization studies, however, have been limited to upper grade levels (Hidi & Anderson, 1986; Stahl, 2004). In a search of Eric, PsycINFO, and Wilson Web for studies in which summarization was an independent variable, a total of 13 studies were found. Six studies were conducted with college students and five studies were implemented with middle and high school students. Only two studies involved fourth graders as participants. The lack of studies that employed summarization as an intervention for elementary grades is also obvious. In a search through ProQuest, 16 dissertations were located that used summarization as an independent variable. One study was conducted with third graders and three studies were done with fifth graders. The remaining 12 studies were implemented with students at middle school or above. The

restriction in participants' grade levels was also obvious in Korea. Using KERIS, a comprehensive search engine that catalogs all kinds of studies produced in Korea, including journal articles and master's theses and doctoral dissertations, only one of the 10 identified studies involved fifth graders. Participants in the other studies were in junior and senior high or college.

Hidi and Anderson (1986) attributed the scarcity of summarization studies conducted with elementary participants to developmental differences in judgment of importance, integration of idea units, and selection or construction of topic sentences. Identification of important information is critical to successful comprehension (Williams, 1988) and is an essential component of summarization (Hidi & Anderson, 1986). In examination of the developmental trend in sensitivity to structural importance with third, fifth, seventh, and college students, Brown and Smiley (1977) revealed that seventh graders and college students were more sensitive to identifying structural importance in comparison to third and fifth graders. Taylor (1986) also found that fourth and fifth graders had difficulties finding and expressing main ideas. The fourth and fifth graders based their selection of content on how interesting the information was to them, rather than weighing the importance of the content relative to the whole text (Taylor, 1986).

In Brown, Day, and Jones' (1983) study, eleventh graders and college students performed better than fifth and seventh graders in examining importance of sentences in a text, and integrating idea units into a summary. The ability to select or construct topic sentences develops very slowly so that even college students exhibit difficulties inventing topic sentences when they are not explicit (Brown & Day, 1983; Garner & McCaleb,

1985). Hidi and Anderson (1986) argued that selection and construction of topic sentences can be completed by adolescents and older students.

Despite young children's difficulty identifying important information and applying summarization rules, developmental differences across grade levels do not necessarily indicate that elementary students cannot learn to summarize. In studies conducted by Brown and Smiley (1977), Brown and Day (1983), and Taylor (1986), students did not receive training for writing a summary. The difference in summarization across different grade levels reflects the extent to which the students already acquired knowledge and skills needed for summarization up to the time when their summarization performance was assessed. For this reason, one cannot be sure how elementary students would perform in writing summaries once they had received instruction.

The difference across age levels is likely to be accounted for by an intervening variable, prior knowledge of content and text structure, for which the testing materials used were not controlled. In Brown and Day's (1983) and Brown and Smiley's (1978) studies, readability of the texts was at a fifth grade level, which was the lowest level of participants. By using the same passages across different age levels, older students are likely to have more prior knowledge of relevant content and text structures and more cognitive resources to allocate to comprehension because of the ease of the text, which likely contributed to better performance in identifying important information.

Jenkins, Heliotis, Stein, and Haynes (1987) and Nelson and Smith (1992) provided third, fourth, and fifth graders instruction in summarization and, as a result, their reading comprehension and ability to identify main ideas improved. Comparing summaries written by students at different age levels, Brown et al. (1983) discovered that

age was not the best predictor for writing quality summaries. Rather, whether students did or did not plan before writing summaries had a greater impact on summarization than age level. Providing instruction in summarization and planning prior to writing a summary are two major factors that contribute to improvement in summary production and reading comprehension for elementary students. Thus, once adequate training is given and students plan beforehand, grade level is unlikely to be an obstacle to learning summarization.

Instructional procedures employed to teach summarization vary. Most typically, a set of summarization rules are taught. Otherwise, summarization guidelines or steps that students should follow to write summaries are offered (Armbruster et al., 1987).

Instructional procedures in teaching a set of summarization rules and offering guidelines or steps take the form of direct instruction. Rosenshine (1983) identified six instructional steps that appear in direct instruction: (a) reviewing previous day's work, (b) presenting content and skills to teach, (c) guided student practice, (d) providing feedback and corrections, (e) independent practice, and (f) weekly and monthly review. These steps became a standard instructional process and are followed in the summarization studies wherein direct instruction is a major instructional approach.

Summarization is also implicitly taught without addressing summarization rules and guidelines or steps (Bean & Steenwyk, 1984; Jenkins et al., 1987). Students were allocated space following each paragraph and were asked to write a summary of each paragraph. Finally, they combined the paragraph summaries into a cohesive summary of the passage (Bean & Steenwyk, 1984). Bean and Steenwyk referred to the implicit teaching of summarization as an intuitive approach. In the intuitive approach, students

were expected to sense that summarization is to concisely integrate important information. The intuitive approach group significantly outperformed the control group on a paragraph summary writing task and a standardized test of paragraph comprehension, Nelson Reading Test, Form B.

Direct instruction proceeds in small steps and detailed instructions and explanations are provided. To enhance students' understanding, many examples are offered and immediate feedback is given. An assignment is broken down into small pieces and students practice each skill until they are automatic (Rosenshine, 1983). Teachers structure lessons by planning instruction in advance and students learn skills by rote. Although the teacher's role fades as students practice independently, the entire lesson is run according to the teacher's preplanning. Direct instruction is criticized for making students passive recipients. Preplanned lessons and overlearning naturally include rote learning and memorization.

In contrast to direct instruction, an alternative instructional approach focuses on inducing students' involvement through scaffolding and facilitating social interaction with and among learners. Instead of letting students learn by themselves, teachers provide responsive assistance. Rooted in constructivism, this perspective views students as constructors of knowledge and teachers as facilitators who enhance interactions with and among students and provide learning environments in which students take on active roles (Vygotsky, 1978).

The concept of the zone of proximal development (ZPD) that Vygotsky (1978) introduced provides practical implications for alternative instruction. The ZPD is the gap between the actual developmental level, in which learners can independently resolve

tasks or problems, and the potential developmental level, where learners can figure out problems with adult guidance or in collaboration with more capable peers (Vygotsky, 1978). Learning takes place in the ZPD through scaffolding, which is a process of assisting novices in solving problems that are beyond their present capabilities (Wood, Bruner, & Ross, 1976). Students are motivated for learning by setting up instructional objectives that are just above students' current skills and knowledge level (Jaramillo, 1996). As students complete the given task with teacher's responsive assistance, they experience a sense of achievement and progress as confident learners. Accordingly, the teacher fades her or his assistance.

In this alternative approach, prompting is the major tool that a teacher employs to enhance students' engagement. Prompts are adjusted in response to the learner's current understanding and need for support, which is called contingency (Stone, 2002). Rodgers (2004) categorized teacher's responsive assistance by the degree of explicitness into four levels: questioning, directing, demonstrating, and telling. Questioning is the least specific prompt and, on the other hand, telling is the most explicit one. The teacher flexibly adjusts the level of assistance in response to students' performance. As students come to succeed in performing the task, the level of a prompt becomes less specific and vice versa.

Scaffolded instruction is represented in Collaborative Reasoning (Waggoner, Chinn, Yi, & Anderson, 1995) and reciprocal teaching (Palincsar & Brown, 1984). Collaborative Reasoning (CR) is a discussion format in which students are encouraged to engage in discussions and think in a reasoned manner about text. Students discuss the question that a teacher poses in small groups. Students state their positions and offer

reasons to support the positions. Students also challenge other students with whom they disagree. The teacher promotes students to develop reasoned argumentation by modeling, prompting, clarifying, summarizing, and encouraging (Clark et al., 2003). In reciprocal teaching, comprehension-fostering skills are taught in an interactive dialogue between a teacher and students (Palincsar & Brown, 1984). In the beginning stages, the teacher initiates the dialogue but as students become more capable of applying the skills, the teacher invites students to initiate discussion and to assume the teacher's role. (Rosenshine & Meister, 1994).

Most studies in which scaffolding was used were conducted with normally developing children but some studies were carried out with students with special needs, specifically those with learning disabilities (Stone, 1998). Palincsar and Brown (1984) applied reciprocal teaching to students who struggled with reading comprehension and found that their reading comprehension significantly improved and their interactions with peers and the teacher became more active over instruction sessions. Bos and Anders (1990) emphasized the importance of scaffolded instruction in teaching students with learning disabilities. The participants in their study were engaged in strategic questioning, organizing, and use of prior knowledge through ongoing dialogue between the teacher and small groups of students. Students in the experimental condition significantly outperformed those in the control group on reading comprehension. Englert, Tarrant, Mariage, and Oser (1994) implemented a didactic instructional program and a scaffolded instructional program to teach reading comprehension strategies to students with mild disabilities. The majority of the participants were identified with learning disabilities. The didactic program was confirmatory and factually oriented, while the scaffolded

instruction program was open-ended and collaborative. During scaffolded instruction, students talked directly to peers, rather than interacting primarily with the teacher.

Students also shared their ideas and extended them by negotiating with peers' ideas. The teacher facilitated students to elaborate on their ideas by asking guiding questions. The students who received the scaffolded instruction program outperformed those in the didactic program on written recall and strategy knowledge, which was evaluated on generating a main idea, asking a question about paragraphs, predicting, and identifying strategies to use.

Scaffolding-oriented instruction includes factors that promote the learning of students with learning disabilities. During scaffolded instruction, the teacher continually assesses students' performance and detects needs for support (Stone, 1998). According to the results from the formative assessment, the teacher may adjust the level of assistance, so students with learning disabilities are less likely to experience cumulative deficits in learning that may result from repeated failure to complete prerequisites. Furthermore, in small groups of heterogeneous members, the likelihood of learning from peers increases (Anderson et al., 2001). Peers are effective contributors who play a role in enhancing the reading performance of students with learning disabilities (Smith, 2004). Generally, students with learning disabilities tend to underachieve compared to their peers at the same ability (Smith, 2004). With fear of failure, students with learning disabilities tend to avoid learning tasks or be passive learners (Pearl, 1982; Torgesen & Licht, 1983). Through scaffolded instruction, students with learning disabilities are invited to get involved in a task that is a little beyond the students' performance level with teacher's

responsive assistance. Hopefully, participants in this study, whether or not they have learning disabilities, will benefit from scaffolded instruction.

The current study examines a new approach to enhance students' active involvement in the learning process and social interaction. In addition to evaluating an attempt to develop an alternative instructional approach, the current study intends to extend the teaching of summarization to lower grade levels. The participants in the current study are fourth graders while the majority of summarization studies have been conducted with students in middle school or beyond. Developing a new instructional approach and extending instruction in summarization to fourth grade will be explored.

Chapter II

Literature Review

Summarization has been an effective skill to improve reading comprehension. In most of the intervention studies where summarization training was provided, reading materials used for instruction and testing were informational texts (Armbruster et al., 1987; Cordero-Ponce, 2000; Day, 1986; Friend, 2001; Gajria & Salvia, 1992; Hare & Borchardt, 1984; Nelson & Smith, 1992; Rinehart et al., 1986; Wood et al., 1995). Teaching summarization is expected to contribute to improving reading comprehension of informational texts, which students increasingly encounter as they proceed to upper grades.

Summarization has been primarily taught to students at middle school or above. In categorization of comprehension strategies, Stahl (2004) classified summarization as being promising but infrequently used in the primary grades. Elementary students participated in only three of 13 intervention studies in which summarization was used. Hidi and Anderson (1986) claimed that young children's inability to acquire summarization skills resulted in the lack of summarization studies that included elementary students. In studies in which performance in summarization was compared across grade levels, older students outperformed younger ones in identifying important information (Brown & Smiley, 1977; Taylor, 1986) and applying high level summarization rules (Brown & Day, 1983). On the other hand, elementary students were also found to improve in reading comprehension and summarization when they learned how to summarize (Jenkins et al., 1987; Nelson & Smith, 1992).

In addition to grade level, instructional approaches that were employed to teach summarization were limited. Almost every study employed direct instruction. In this review, direct instruction is explained in terms of its origin and instructional procedures. Moreover, an instructional approach that can be alternative to direct instruction is explored in order to surmount the weakness that results from direct instruction. Measures that have been employed to assess the effects of the intervention are also reviewed.

Summarization Across Grade Levels

Stahl (2004) classified comprehension strategies used for primary grades into four categories, based on whether strategies are research-based and whether teachers frequently use the strategies. According to the classification, summarization is a promising strategy but not widely used in the primary grades. Perhaps, the minimal use of summarization in the primary grades can be attributed to the results of studies that show differential performance in summarization by participants' grade level.

Identification of main ideas is a critical summarization skill (Thistlethwaite, 1991). Brown and Smiley (1977) examined the developmental trend in sensitivity to structural importance with third, fifth, and seventh graders, and college students. Two unfamiliar fairy tales with comparable readability levels and equal length were used. The two stories were divided into idea units and, moreover, idea units in one of them were rated by structural importance to the story theme from 1, least important, to 4, most important. One story was used for students to practice rating the structural importance of idea units and the other story was used to test students' rating performance.

For practice and testing, third and fifth graders were individually seen twice. On the first day, they read two-sentence passages and practiced finding important words or phrases with the experimenter. Then, each student was provided a copy of the practice story, which was broken into pausal units. A student read the story twice as he or she listened to a tape recording. Following individual reading, while the student and the experimenter read the story through together, the experimenter crossed out the idea units by the level of importance and explained the reason for removal. On the following day, each student read another story twice as he or she listened to a tape recording. Then, students were asked to rate the units by the level of importance. Seventh grade and college students were seen in groups. The same procedures were followed with the third and fifth graders except they were not offered opportunities to practice rating the pausal units of two-sentence passages with the experimenter. Instead of collaborative practice, seventh graders and college students were told that the idea units in a practice story varied in terms of structural importance to the story theme.

Third graders did not distinguish idea units reliably among the four levels of importance. Fifth graders were good at differentiating the most important units from the rest but could not do well in gradating idea units across the other three importance levels. Seventh graders could differentiate low-importance from high-importance units but they were not sensitive to distinctions between medium levels of importance. College students showed the highest sensitivity in rating importance.

Taylor (1986) conducted two experiments with fourth and fifth graders to investigate the potential difference in summarization of narrative and expository texts. Participants in the two experiments were average or above in reading ability. An

expository passage and a narrative passage of about 300 words were selected from fourth- and fifth-grade textbooks that had not been used in the participants' school district. Students read a story and an article and wrote a summary of each text. The written summaries were evaluated by four panelists in terms of accuracy/clarity, brevity, inclusion of main idea, and use of students' own words. The written summaries of a narrative text were not significantly different than those of an expository article on the four aspects. All students at both grade levels had difficulties finding the main idea irrespective of text genres, although they reported during an interview that the expository article was more difficult to summarize than the narrative.

In addition to the differences in identifying important information across age levels, the ability to use summarization rules was compared across four different grade levels (Brown & Day, 1983). Eighteen fifth graders, 16 seventh graders, 13 tenth graders, and 20 college students participated in summarizing two expository texts that were excerpted from seventh-grade geography texts and that were modified so that five summarization rules could be applied in written summaries. The rules were *deletion of unimportant information, deletion of redundant information, superordination of lists, selection of a topic sentence, and invention of a topic sentence*. The two passages were nearly comparable in length, readability level, and number of idea units.

Students read a passage three times and wrote a summary of the passage without any constraint on length. Immediately following completion of the first summary, students were requested to write a second 60-word summary of the same passage without referring to the first summary. Students were allowed to take notes, underline, or draft a

summary and they could use notes, underlined text, and the draft to write the brief summary.

Fifth graders did not significantly differ in using the *deletion of trivial and redundant information* rule than students at the other grade levels. Students, however, showed significantly different performance in applying the other three summarization rules. Fifth and seventh graders employed the *superordination* rule significantly less frequently than tenth graders and college students. Older students applied the *selection of topic sentences* rule significantly better than younger students. Interestingly, when the number of words in a summary was constrained, college students applied the *selection of topic sentences* rule less frequently than when there was no constraint in length. Differences in the *invention of topic sentences* were also significant across grade levels. Fifth and seventh graders could invent topic sentences on 14% and 28% respectively of occasions where invention was appropriate. College students, on the other hand, were successful on half of the occasions where invention could be applied. Given that each of the five rules could be applied three to five times at a text, fifth and seventh graders used the *invent topic sentences* rule only once or did not use it at all in their summaries.

According to the findings by Brown and Smiley (1977), Taylor (1986), and Brown and Day (1983), age or grade level is a critical factor that accounts for differences in employing summarization skills. Age, however, is not the best predictor of good written summaries. Brown et al. (1983) investigated development of summary writing and planning activities prior to and during a summarization task with fifth (n=15), seventh (n=16), eleventh (n=15), and first-year college students (n=11). The folk tales

used were comparable in length (i.e., about 500 words), number of idea units (60), and readability level (i.e., fifth grade as measured by the Dale-Chall Index).

Two stories were randomly assigned to each student. Students took the two stories home in order to learn them to the extent that they could remember the themes and trivial details of the stories in their own words. The students could spend as much time as they wanted and kept track of the time that they spent learning the stories. One week later, the students were asked to write whatever they could recall about each story and, then, to write a summary of a randomly selected story using the fewest words, as if they were newspaper reporters. While writing a summary, a copy of the story was available to students and unlimited time was given. Students wrote two more summaries of the same story, one with limited length up to 40 words and another one using 20 words. They could use a sheet of scratch paper to practice writing or to draft a summary.

In analysis of the three summaries of the same story, the importance level of idea units that were included in the summaries was significantly different across the four grade levels. As the length of summaries was limited, seventh graders, eleventh graders, and college students included more important idea units in comparison to fifth graders. Fifth and seventh graders depended on a copy-delete strategy but eleventh graders and college students wrote summaries by combining and rearranging idea units. These results are not new because older students' ability to include more important ideas and apply high level summarization rules was previously confirmed in research (Brown & Day, 1983; Brown & Smiley, 1977). Brown et al. (1983), however, found an interesting point in planning activities in relation to summarization across age levels. Planning activities were examined by looking at the scratch sheet that students used to prepare a draft.

Significantly more eleventh graders and college students drafted summaries on the scratch sheet before they wrote the final summaries than fifth and seventh graders. Only 2 of 15 fifth graders attempted to make a rough draft. Based on this finding, Brown et al. claimed that planning activities, not age level, was the best predictor for writing good summaries.

In conclusion, ability to identify important information and to apply diverse summarization rules seem to improve with students' age. Even fifth graders could do well in simply differentiating important from unimportant information (Brown & Day, 1983; Brown & Smiley, 1977), but students at lower grades relied heavily on the copy-delete strategy, while students at higher grade levels could apply diverse summarization rules (Brown et al., 1983). Although students differed in their application of summarization skills across age levels, Brown et al. (1983) found that planning a summary, not age, is the best predictor of effective summarization. Based on this finding, age and grade level may not be an obstacle to learning summarization. Planning needs to be embedded in summarization instruction.

Moreover, differentiating idea units by level of importance is closely associated with whether students had acquired prior knowledge relevant to a given passage. When passages used for testing were drawn at the readability level of students at the earliest age, older students were likely to be better at differentiating import from unimportant information than younger ones because of their cumulative knowledge base. In order to compare differences across grade levels, the effect of background knowledge should be considered.

Summarization of Younger Children

In all of the studies that showed older students' superiority in identifying important information and applying higher level summarization rules, summarization instruction was not provided. Rather, summarization was a dependent measure. Younger students' inability, which was found when no intervention was given, does not indicate that young children cannot learn to summarize. Children in primary grades tended not to be taught summarization due to their low performance in finding important information and applying higher level summarization rules. Their low performance, on the other hand, can be a reason why young children should be offered instruction in summarization. Despite the lack of studies in which young children were taught summarization, the two studies reviewed in the following section reveal that even third and fourth graders could learn to write summaries and that their comprehension improved as a result.

Third grade is the earliest level that summarization was taught. Jenkins et al. (1987) recruited 32 students with learning disabilities (i.e., 4 third, 12 fourth, 11 fifth, and 5 sixth graders), all of whom struggled with decoding and comprehension. The students were randomly assigned to either an experimental or a control group. The experimental group received restatement training, whereas the control group dealt with their regular seatwork.

Restatement training was given over three phases. During the first phase, students were provided with a narrative text including spaced lines following each paragraph. Students were instructed to identify the most important person and the major event in each paragraph and were provided with two guiding questions: who? and what's

happening? In the second phase, students heard from instructors that the paragraph restatement should contain the fewest words possible. Students individually wrote a brief summary in the lined space following each paragraph and elaborated on the summary to include the fewest possible words yet still capturing the gist of the major event. In the third phase, lined space was not given. Rather, students were provided with a separate sheet of paper.

Narrative texts at second and third grade readability were used for instruction and testing. The effect of paragraph-summarization training was evaluated through oral retellings and comprehension questions. Based on the pretests of oral retellings and comprehension, which were executed 3 weeks before the training sessions started, students were stratified into two groups and then randomly assigned to either an experimental group or a control group. Posttests were administered in three forms: test of training, near transfer test, and remote transfer test. In the test of training, students wrote paragraph summaries of a narrative text and retold the story. They also completed the comprehension test. In the near transfer test, students were provided with a story, in which lined spaces were not given, and a separate sheet of paper without directions for its use. Students answered comprehension questions but did not retell the story. In the remote transfer test, the text did not have lined spaces and students were not given an additional sheet of paper. Oral retellings and comprehension questions were administered to the students.

On the test of training, the experimental group significantly outperformed the control group in the oral retellings and comprehension test, whereas the experimental group was not significantly better in sensitivity to the relative importance of idea units

than the control group. For the near transfer test, the experimental group performed significantly better than the control group on comprehension questions. For the remote transfer test, the experimental group recalled significantly more items and outperformed the control group on the comprehension test.

While Jenkins et al. (1987) showed that the third and fourth graders' sensitivity to the relative importance of idea units did not substantially improve as a result of paragraph-restatement training, Nelson and Smith (1992) found a meaningful increase in inclusion of important information. In Nelson and Smith's study, summarization was taught to 2 fourth, 2 sixth, and 1 eighth grader identified with learning disabilities. Intervention was provided in group- and independent-reading settings. In the group-reading setting, an introductory session was followed by instructional sessions. During the introductory session, steps involved in writing a summary, purpose of instruction, and the relationship of summarization to understanding informational text were presented. During the instructional sessions, the summarization steps were reviewed and the teacher demonstrated using the steps in the group reading setting. The teacher assisted students in writing a summary by applying the steps.

In the independent reading setting, students wrote a summary following the summarization steps as they received teachers' help only with spelling words. After they completed the summary, they took a comprehension test. Four weeks after the intervention was terminated, students were asked to verbally state the nine summarization steps and to write a summary of a science passage. They also took a comprehension test on the passage that they summarized in writing.

Completeness of a written summary and reading comprehension were assessed as dependent variables. Completeness of a summary was defined as the percentage of important information included in a summary. Reading comprehension was assessed using 10 multiple-choice questions. To obtain baseline information, students' performance in completeness of a summary and reading comprehension was assessed in group- and independent-reading settings. In a group setting, after a teacher read a passage selected from a science text, students wrote a summary and took a comprehension test on the passage. In the independent setting, students read an expository passage and wrote a summary independently. In both settings, the teacher helped students with word recognition. As instructional sessions proceeded, the percentage of important information included in summaries increased for the 5 students. Reading comprehension also substantially improved over intervention sessions. When the students took the follow-up test 4 weeks after the intervention ended, they still maintained their performance in summarization and reading comprehension.

As seen in Jenkins et al. (1987) and Nelson and Smith (1992), third and fourth graders' performance in reading comprehension and finding important information was escalated once they learned summarization. According to these findings, the lower graders' difficulty in identifying important information and applying summarization rules (Brown & Day, 1983; Brown & Smiley, 1977; Taylor, 1986) provides a rationale for teaching summarization, rather than withholding instruction of the skill. The finding that planning is a better predictor of effective summarization than age (Brown et al., 1983) offers a component that should be included in summarization instruction.

Summarization instruction varies with the content that is taught. Explicitly teaching summarization rules was most typical. Providing guidelines or steps that should be followed to write a summary is another form of instruction. In addition, students were guided to intuitively learn to summarize by confining the number of words included in written summaries. In the following section, the content of summarization instruction is explained.

Content of Summarization Instruction

The primary content that was taught during instruction in summarization is rules that Brown and Day (1983) derived from semantic macrorules that Kintsch and van Dijk (1978) identified. Kintsch and van Dijk determined three semantic macrorules: deletion, generalization, and integration. Brown and Day fractionized the three macrorules into six basic rules of summarization: (a) deletion of unimportant, trivial information, (b) deletion of redundant information, (c) substitution of a superordinate term or event for a list of items, (d) substitution of a superordinate action for a list of subcomponents of the action, (e) selection of a topic sentence, and (f) invention of a topic sentence. These six summarization rules have been the pivot upon which summarization training has been based since the 1980s. In an intervention study, Day (1986) combined the two superordination rules and finally identified five summarization rules.

Based on the rules by Brown and Day (1983), Rinehart et al. (1986) generated four summarization rules: (a) identify/select main information, (b) delete trivial information, (c) delete redundant information, and (d) relate main ideas with important supporting information. Rinehart et al. did not believe that six graders could learn the

superordination rule and the identification or invention of topic sentences rule, so these two rules were modeled but not explicitly taught. Brown and Day's summarization rules have continuously been employed in summarization training programs with minor modifications (Cordero-Ponce, 2000; Gajria & Salvia, 1992; Rogevich & Perin, 2008).

The five summarization rules that Day (1986) identified, however, do not reflect how selected important ideas, superordinate terms/actions, and topic sentences are integrated into a cohesive summary. Hare and Borchardt (1984) elaborated upon the summarization rules by adding an integrating rule. Hare and Borchardt extracted four summarization rules from the six rules that Brown and Day (1983) determined: (a) collapse lists, (b) use topic sentences, (c) get rid of unnecessary detail, and (d) collapse paragraphs. *Collapse lists* corresponds to superordination rule. *Use topic sentences* pertains to selection and invention of a topic sentence. *Get rid of unnecessary detail* involves removing unimportant, trivial, and redundant information. *Collapse paragraphs* is to keep paragraphs explaining other paragraphs and to delete the other paragraphs. Collapse paragraphs rule extends the superordination rule to the level of paragraph. In addition to the four rules, Hare and Borchardt generated *polishing the summary* rule. Although important ideas and topic sentences are selected and a list of items or actions are substituted with superordinate terms, summarization is beyond simply enumerating important ideas, topic sentences, and superordinate terms. *Polishing* rule addresses supplementing with introductory or closing statements, naturally linking sentences with connecting words, and writing a summary in one's own words.

Another trend in teaching summarization was to introduce guidelines or steps to be followed to write a summary. Armbruster et al. (1987) explicitly introduced guidelines

that were tailored to summarize passages of problem/solution structure. Students were asked to write three sentences, each of which corresponds to three components of problem/solution structure: problem, action, and results. Following summarization, students reviewed their summaries to confirm if the summaries met four instructions on a checklist. The checklist addressed inclusion of the three components, usage of complete sentences, linkage of sentences with connecting words, and correct grammar and spelling.

Bean and Steenwyk (1984) referred to explicitly teaching summarization rules as a rule-governed approach and compared the rule-governed approach with an intuitive approach, called GIST, in which students were expected to intuitively notice features of summarization as they paraphrase. The first sentence of a paragraph was displayed and students wrote a sentence summary of 15 or less words. During summarization, students could not refer to the sentence. Next, the first two sentences were displayed and students summarized the sentences with one sentence of 15 or less words. This process continued until the whole paragraph was displayed and students wrote a one-sentence summary of the whole paragraph.

Jenkins et al. (1987) and Malone and Mastropieri (1991) also applied intuitive methods but, in addition to providing a blank line following each paragraph, they provided two guiding questions: (a) Who is the paragraph about? and (b) What's happening? Students were supposed to use the answers to write a summary sentence in the blank provided after each paragraph. Although, in both studies, teachers provided corrective feedback, teacher's roles were minimal when summarization was instructed through the intuitive approach, compared to explicitly teaching summarization rules and introducing guidelines or steps. Students were expected to notice that summaries should

be concise and cohesive. Bean and Steenwyk (1984), Jenkins et al. (1987), and Malone and Mastropieri (1991) revealed that students to whom summarization was intuitively taught improved on reading comprehension. Furthermore, the group in which intuitive approach was employed performed as well as the group in which summarization rules were explicitly taught through rule-governed approach on reading comprehension and use of summarization rules (Bean & Steenwyk, 1984).

Irrespective of the content of summarization instruction, in almost all summarization studies, instructional procedures reflected the features of direct instruction. (Armbruster et al., 1987; Bean & Steenwyk, 1984; Day, 1983; Jenkins et al., 1987; Malone & Mastropieri, 1991; Rinehart et al., 1986). Direct instruction has been a dominant instructional approach when summarization was taught. In the next section, the origin and features of direct instruction are explained in detail and an alternative instructional approach is proposed.

Instructional Approaches to Teaching Summarization

Direct instruction has been challenged as promoting learner's passivity and, as a result, making it hard for students to acquire higher level cognitive functions. For this reason, social constructivism is explored as a theoretical framework on which to develop an alternative instructional approach that enhances student's involvement and fosters higher cognitive functions. In the first subsection, features of direct instruction are described and intervention studies involving direct instruction are reviewed. In the second subsection, an instructional approach that is alternative to direct instruction is suggested.

Direct instruction. The term, *direct instruction*, has been used in two different ways. First, the capitalized term, Direct Instruction, originated from Bereiter-Engelmann Preschool in the 1960s and was developed as a program called Follow Through that was funded by U. S. Office of Education. The Follow Through Program was offered for economically disadvantaged children in grades K-3. The program was characterized as being intensive, carefully sequenced, teacher-directed, small-group, and verbal instruction (Becker, Engelmann, Carnine, & Maggs, 1982). Engelmann and his colleagues developed a series of reading and arithmetic programs called DISTAR. DISTAR originally stood for Direct Instruction System for Teaching Arithmetic and Reading but the acronym was later changed to Direct Instruction System for Teaching and Remediation (Adams & Engelmann, 1996).

Direct Instruction programs consist of carefully sequenced curricula and follow strictly controlled instructional processes (Sexton, 1989). Direct Instruction is a comprehensive system of instruction that involves classroom organization and management, prescribed teacher-student interactions, and closely sequenced design of curriculum materials (Gersten, Woodward, & Darch, 1986). Direct Instruction programs developed by Engelmann and his colleagues share the following basic features: “(a) pretested scripted lessons, (b) teacher-directed group instruction for part of each lesson, (c) specified teaching, motivating, and training procedures, (d) built-in systems for monitoring student progress, and (e) a common logic in selecting teaching materials, examples, and program sequences” (Becker et al., 1982, p. 155).

In commercial Direct Instruction programs, daily lessons are scripted to teach specific objectives and the sequence of curricular materials is carefully arranged

(Carnine, Silbert, & Kameenui, 1997). The scripted lessons provide all the details about what a teacher does and says. Lessons in Direct Instruction are conducted in small groups. Compared to one-on-one instruction, small group instruction is more efficient in that teachers can provide more time to instruction than is possible with one-on-one teaching. Additionally, most schools cannot afford one-on-one instruction (Carnine et al., 1997). Based on pretest performance, small groups are composed of students homogeneous in skills that are necessary to complete a particular task. The groups consisting of students with advanced skills include more students and the groups composed of students with less advanced skills contain fewer members. Advanced groups progress quickly and less advanced groups take more time to practice.

The lower case term, *direct instruction*, indicates a generic teaching model that is extracted from effective instructional programs inclusive of a Direct Instruction Programs (Rosenshine, 1983; Rosenshine & Stevens, 1986). Rosenshine reviewed correlational and experimental studies in which teacher training successfully led to improvement in student academic achievement and identified common features of instructional programs executed across the studies (Anderson, Evertson, & Brophy, 1979; Becker, 1977; Emmer, Evertson, Sanford, & Clements, 1982; Evertson, Emmer, Sanford, & Clements, 1982; Fitzpatrick, 1981; Good & Grouws, 1979; Reid, 1978-82). The common features of the instructional programs that Rosenshine deemed effective are structuring learning, proceeding in small steps but at a brisk pace, providing detailed instructions and explanations, offering many examples, asking many questions that students can easily answer, giving immediate feedback and corrections, breaking down an assignment into small pieces, and providing opportunities for student practice. The format of grouping

was not specified in direct instruction, whereas Direct Instruction programs were conducted in small groups that consisted of homogeneous students.

Based on the common features, Rosenshine (1983) generated six instructional steps of direct instruction, which became a standard format of direct instructional procedures. The first step is reviewing the previous day's work. At the beginning of the lesson, the teacher checks students' mastery of prerequisite skills. The teacher checks homework and gives feedback, as necessary. The teacher may also ask questions to ensure students' retention of prerequisite skills for the lesson. The second step is presenting content and skills that students will learn in the lesson. A teacher provides redundant explanations for difficult points and gives varied examples so that all students can understand. Presentation of new content and skills is conducted in small steps and one point is addressed at a time. The third step is guided student practice. A teacher leads students to practice new skills by asking many brief questions and correcting student responses. Student practice continues until they can use the skills with confidence. The fourth step is providing feedback and correction in response to student answers. The fifth step is students' independent practice. As students successfully complete guided practice, they proceed to independent practice. Students put all the steps and skills together and practice until they can automatically use those skills. During independent practice, individual students work alone on seatwork. A teacher has to maintain student engagement during seatwork. The sixth step is weekly and monthly review. A teacher conducts reviews to ensure that students learned the skills and to check her or his teaching pace. When students are known to be weak in particular areas, the areas are retaught (Rosenhine, 1983).

Direct instruction does not include details (i.e., scripts, materials, and corrective feedback) about how a teacher conducts a lesson, which characterizes Direct Instruction programs. Instead, direct instruction involves generic procedures that teachers follow to conduct a lesson. Rosenshine (1976) referred to direct instruction as patterns of teacher behavior that are related to high levels of student academic achievement. While Direct Instruction pertains to how curricular materials should be constructed, direct instruction focuses on teacher behavior and classroom organization (Gersten, 1985).

The features of direct instruction (i.e., proceeding in small steps, providing detailed instructions and explanations, offering many examples, breaking down an assignment into small pieces, and providing opportunities for student practice) are reflected in summarization studies. Hare and Borchardt (1984), for example, provided varied examples of summaries in which each summarization rule was applied and broke summarization rules down into small pieces. Cordero-Ponce (2000) also taught one summarization rule at a time and stayed on the rule until students could fluently use it. The instructional steps that Rosenshine (1983) generated became a typical format of instructional procedures. Armbruster et al. (1987) offered explicit explanation for the rationale of learning summarization, followed by instructor's demonstration, guided student practice, and independent work. Students were provided with corrective feedback at the beginning of every session as well. The instructional steps are similarly followed in current studies on summarization (Friend, 2001; Rogevich & Perin, 2008).

Direct-instruction procedures inevitably result in learners' passivity and impede peer interaction. The entire task is broken down into subcomponents and students practice one subcomponent at a time until they almost automatically perform it

(Rosenshine, 1983). For this reason, students do not have opportunities to implement the entire task until they master all fractions of the entire task. In summarization studies, students practiced one or two rules or steps at a time until they got used to applying each rule or step. All the rules or steps were combined in a written summary when students reached mastery in applying each rule or step. While, in the perspective of advocates of direct instruction, overlearning is the way to higher cognitive processing (Rosenshine, 1983), the process of overlearning necessarily involves rote memorization (Tharp & Gallimore, 1989).

Except for guided and independent practice, the teacher dominates most of the lesson time and initiates instruction in direct instruction. Given that students work alone during independent practice, peer interaction is likely only during guided practice. During guided practice, however, most interaction occurs between the teacher and the individual student who receives the teacher's corrective feedback, rather than among students. In this regard, learning seems to occur only in an individual aspect, which Handsfield and Jiménez (2008) referred to as "the confines of the brain".

As opposed to direct instruction, an alternative instructional approach focuses on learner's active involvement in learning process and sociocultural aspects of learning. A learner's activity and sociocultural context in the learning process are key concepts of constructivism. The following section provides an overview of instructional perspectives based on constructivism and suggests an instructional approach that can be an alternative to direct instruction in teaching summarization.

Alternative instruction. In a constructivist perspective, learners actively participate in the learning process and construct their own understandings, rather than

acquiring knowledge transmitted from the teacher (Holden, 2002; von Glasersfeld, 1989). Instead of being a knowledge transmitter as seen in traditional instruction, the teacher is a facilitator who enhances interactions with and among students and provides a learning environment in which students take on active roles.

Constructivism, as a theory of how humans construct meaning, is largely attributed to Piaget and Vygotsky. Piaget (1950) conceptualized the mechanism of children's cognitive development by virtue of two concepts, assimilation and accommodation. When learners encounter new information and knowledge that are consistent with their own knowledge structures, they incorporate and internalize the new information and knowledge into their existing framework, which is referred to as assimilation. Accommodation takes place when individuals find that their own ideas do not serve to understand new experiences. Learners reframe their mental representation of the external world to accommodate the new experiences. Human cognition continues to develop through the process of equilibrium between assimilation and accommodation. Although assimilation and accommodation emphasize the intrapersonal aspect of cognitive development, Piaget believed that children organize and communicate their thoughts through socialization and they expand their thinking and views of reality through peer interaction. As children confront peer's different views in peer interaction, cognitive conflict takes place, which brings about the need for cognitive elaboration (Piaget, 1950).

Vygotsky (1978) highlighted the sociocultural aspect in constructing knowledge. According to Vygotsky, learning occurs through social interactions among more culturally knowledgeable persons and less knowledgeable ones. Higher mental functions

first build on the social interaction between people and then these mental functions are developed on the individual level. Vygotsky focused primarily on the interpsychological plane in development of higher mental functions.

Vygotsky (1978) introduced the concept of zone of proximal development (ZPD) to describe how learning takes place. The ZPD is the gap between the actual developmental level, in which learners can independently resolve tasks or problems, and the potential developmental level, where learners can figure out problems with adult guidance or in collaboration with more capable peers (Vygotsky, 1978). The ZPD is the point where teaching functions and virtual learning takes place. Teaching is useless in the zone in which learners are able to successfully perform without assistance. In the area beyond the ZPD, where learners cannot succeed even with assistance, teaching is helpless. Students are motivated for learning when instructional objectives are just above students' current skills and knowledge level (Jaramillo, 1996). As students complete the given task with teacher's responsive assistance, they experience a sense of achievement and progress as confident learners.

Parents and teachers are typical providers of assistance or guidance. Additionally, Vygotsky (1978) argued that learning would occur when children collaborate with their peers. The peers should not necessarily be more capable and they cannot be experts in all tasks. Even though a peer is more capable than other peers and can help the others in a task, he or she may need assistance in another task. When children encounter difficult problems beyond their expertise, they, as a group, can generate solutions to the problems that they would not deal with alone (Wells, 1999).

The ZPD continues to shift as students expand their knowledge through scaffolding (Lee & Smagorinsky, 2000). The concept of scaffolding was introduced to explain the interaction that takes place between a tutor and a tutee (Wood et al., 1976) but scaffolding is extensively used in group instruction (Cazden, 2001; Maloch, 2002). Wood et al. described scaffolding as a process of assisting novices in solving problems that are beyond their present capabilities. Based on the features of scaffolding that Wood et al. identified and a review of literature on scaffolding in the 1980s, Stone (1998) extracted four key features of scaffolding. First, an adult engages a child in a meaningful activity that is beyond the child's current level of competency. Second, assistance is carefully provided based on formative assessment of the child's skill level and understanding. Third, the types of support range from nonverbal to verbal assistance. Teacher demonstration is typical of nonverbal assistance. Dialogue, as an important medium for scaffolding (Meyer, 1993), between a teacher and students is a type of verbal assistance. Fourth, the assistance is temporary and is gradually reduced as the child's performance improves. The responsibility for learning transfers from the teacher to students, so students gradually increase independence.

Stone (2002) reconceptualized scaffolding in terms of three aspects: context, contingency, and challenge. Context is a situation in which a teacher and learners engage in activities with joint goals that foster social interaction. Contingency indicates that teacher's assistance corresponds to learner's current understanding and need for support. Assistance contingent on students' current competence level is based on formative assessment of student performance. The task given to students needs to be challenging so

that it can stimulate the students to develop beyond their current level of competence. The task, however, should not be so difficult that students cannot solve it.

Considering the three aspects of scaffolding, direct instruction differs from scaffolded instruction. When it comes to context, social interaction that scaffolded instruction emphasizes is not likely to occur in direct instruction. Students are grouped with peers in scaffolded and direct instruction but the intent of grouping differs. In direct instruction, groups are formed with homogeneous members and the purpose of grouping is on efficiency and convenience (Rosenshine, 1979). In contrast, in scaffolded instruction, heterogeneous groups are formed to facilitate social interaction (Maloch, 2002). In terms of contingency, the difference between both instructional approaches is clear. While a teacher conducts a lesson using predetermined plans in direct instruction, the teacher in scaffolded instruction continuously adjusts her or his assistance level according to students' level of performance. Both approaches also differ in the extent to which a task is challenging. In direct instruction, a task is broken down into small pieces so that students can more easily achieve mastery (Rosenshine, 1983). Students repeatedly practice each piece until they can automatically apply it. Even questions that a teacher poses are intentionally easy so that most students can answer without failure. Scaffolded instruction motivates students to learn by setting up instructional objectives that are just above students' current skills and knowledge level (Jaramillo, 1996).

Scaffolded instruction is well reflected in CR and reciprocal teaching. CR is a small group format in which students are encouraged to engage in discussions and think in a reasoned manner. Students silently read a story involving controversial issues. A teacher poses a question that elicits alternative perspectives and students discuss the

question in small heterogeneous groups. Students are allowed to state their positions without teacher's nomination unless they interrupt other students' remarks. Students offer evidence to support their positions and they also challenge other students with whom they disagree. During discussion, students explore multiple perspectives of an issue. The major role of teachers in CR is to promote their students developing reasoned argumentation (Clark et al., 2003). In this role, a teacher models, prompts, clarifies, summarizes, and encourages (Clark et al., 2003). A teacher demonstrates her or his thinking out aloud. The teacher also prompts students to offer evidence for their positions or requests clarification of their positions. The teacher summarizes what students have discussed and encourages them to participate in discussion or to raise an alternative point of view. In order not to intervene with students' participation in discussions, the teacher does not state interpretative conclusion about the accuracy or inaccuracy of students' responses (Chinn, Anderson, & Waggoner, 2001). Teacher's use of interpretative authority is found to interrupt genuine discussion (Almasi, O'Flahaven, & Arya, 2001). When discussions go on, the teacher stays silent (Chinn et al., 2001).

During discussion, students express their positions and provide reasons or evidence to support the positions. Students also have opportunities to observe how other students use argument stratagems. When a student finds peers' argument stratagems to be functional in discussion, the stratagems are likely to spread to other students and to be more frequently used. Anderson et al. (2001) referred to this as the snowball phenomenon. The snowball phenomenon is a good explanation of how social interaction among students fosters their learning. In direct instruction, skills are taught primarily by a

teacher, whereas peers, in CR, serve as a good model of using skills without teacher's explicit modeling.

Reciprocal teaching (Palincsar & Brown, 1984) is an instructional procedure wherein four comprehension-fostering skills, generating questions, summarizing, clarifying, and predicting, are taught in an interactive dialogue between a teacher and students. During the early stages of reciprocal teaching, the teacher explicitly models using the four comprehension skills on a segment of text and students practice the skills on the following segment of text with teacher's assistance (Rosenshine & Meister, 1994). In the beginning stages, the teacher initiates the dialogue but as students become more capable of applying the skills, the teacher invites students to initiate discussion and to assume the teacher's role. To provide guidance for students in reciprocal teaching, the teacher models, prompts, gives instruction, modifies the activity, praises, and provides corrective feedback (Palincsar & Brown, 1984). As students take over the teacher's roles, they offer questions other than the question that a teacher poses, comment on another student's summary and predictions, and request clarification (Rosenshine & Meister, 1994).

Stone (2002) classified the teacher's moves represented in scaffolded instruction such as CR and reciprocal teaching by the extent of teacher assistance and arranged them in a hierarchical order. Stone explained the hierarchy of prompts by referring to the project of building blocks in Wood et al. (1978). Prompts are classified into giving general encouragement, offering specific verbal information, indicating appropriate pieces, providing prepared subassembly, and demonstrating assembling blocks (Stone, 2002). Demonstrating is the most explicit assistance that is given when students have no

prior knowledge or understanding of a task. As students come to succeed in performing the task, the level of prompt becomes less specific.

Rodgers (2004) categorized responsive assistance to students who struggle with reading into four levels: questioning, directing, demonstrating, and telling. Questioning, as the least specific assistance, is for a teacher to pose questions to students. Directing students to take a specific action follows questioning. A teacher demonstrates the process of problem-solving. When students do not respond well to demonstration, a teacher directly tells the students an answer. Given that contingency is a primary aspect of scaffolding, it should be an essential part of alternative instruction in summarization. Stone's (1998) and Rodgers' classifications of teacher moves will be mirrored to construct the structure of alternative instruction in summarization.

Teacher's prompts are used to incite students' responses and, as students' engagement increases, teacher moves are translated into peer interactions. To enhance peer interactions in CR, the teacher did not use interpretative authority and stayed silent during students' discussions (Chinn et al., 2001). Maloch (2002) suggested ways to help students develop interaction skills during literature discussion groups. Instructors frequently invite students to discussion and reinforce students' engagement by acknowledging and praising their involvement. Students are encouraged to take over the lead and adopt the teacher moves in discussions over time. The instructors will not appoint group leaders. Rather, students may voluntarily serve to lead their groups at their decision. When student interactions increase, the instructors will smoothly fade their roles (Maloch, 2002).

The alternative instruction for this study is designed to represent scaffolding and active social interaction. Contingency, a key feature of scaffolded instruction, is the primary principle of the alternative instructional approach. Rather than following predetermined procedures, teacher assistance will be continually adjusted in accord to students' performance. Contingent instruction does not mean that the lesson is improvised. Rather, a scaffolded lesson is designed with a flexible structure. The lesson varies depending on formative assessment of students' performance in real time. To teach in a contingent manner, a teacher needs to be facile in adjusting her or his prompts in response to students' competencies. As the teacher provides the appropriate level of assistance to the extent that students are motivated to deal with problems, students are likely to interact with one another to solve the problems in small groups.

The alternative instructional approach will be referred to as collaborative summarization in that summarization is taught based on collaboration among peers. Collaborative summarization is expected to be more effective than direct instruction. Generally, the effectiveness of direct instruction was measured in terms of reading comprehension and summarization. The following section provides detailed information on measures used to assess the effect of intervention.

Measures of the Effect of Summarization Training

In previous intervention studies, the effectiveness of summarization training was assessed on measures of reading comprehension and written summaries. In almost all summarization studies, reading comprehension was a primary dependent variable (Armbruster et al, 1987; Cordero-Ponce, 2000; Gajria & Salvia, 1992; Hare & Borchardt,

1984; Nelson & Smith, 1992; Rinehart et al, 1986; Rogevich & Perin, 2008; Wood et al., 1995). Evaluation of written summaries was the secondary dependent measure (Armbruster et al, 1987; Cordero-Ponce, 2000; Day, 1986; Friend, 2001; Gajria & Salvia, 1992; Hare & Borchardt, 1984; Nelson & Smith, 1992; Rogevich & Perin, 2008; Wood et al., 1995). The following sections provide a review of the varied measures used to assess reading comprehension and written summaries.

Assessment of reading comprehension. Because comprehension is the ultimate goal of reading and an indicator of how readers employ the “subprocesses of reading” (McKenna & Stahl, 2003, p. 7), measurement of comprehension has been a persistent challenge to researchers. McKenna and Stahl identified the three major approaches to assessing reading comprehension as questions, cloze, and oral retellings. Measures of reading comprehension that were most typically used in the pool of summarization studies are multiple-choice (Gajria & Salvia, 1992; Nelson & Smith, 1992; Wood et al., 1995) and recall tests (Armbruster et al., 1987; Cordero-Ponce, 2000; Rinehart et al., 1986; Wood et al., 1995).

Multiple-choice tests. Multiple-choice tests were the most frequent method used to assess reading comprehension. Gajria and Salvia (1992) recruited 30 students with learning disabilities in grades 6-9 and 15 students without disabilities at the same grade levels. Thirty students with learning disabilities served as experimental and control groups and 15 students without learning disabilities served as a comparison group. To compare the experimental group with the control and comparison groups in reading comprehension, students read an expository text and answered 10 multiple-choice questions at pretest, posttest, and maintenance test, and alternate forms of the

comprehension subtest of the Gates-MacGinitie Reading Tests (Gates & MacGinitie, 1989) was given to the experimental group at pretest and posttest. Each multiple-choice test was composed of five condensation questions and five factual questions. Condensation questions reflected comprehension of main ideas, cause-effect relationships, concepts, and inferences. Factual questions addressed explicitly stated facts. The experimental group performed significantly better on condensation questions than the control and comparison groups. With factual questions, the performance of experimental group significantly outperformed the control group but did not significantly differ from the comparison group. To measure maintenance of summarization skills, a comprehension test was given to the experimental group 4 weeks after the training was terminated. The experimental group performed at the same level on condensation and factual questions as they had on the immediate posttest.

Nelson and Smith (1992) investigated how teaching summarization skills contributed to improving reading comprehension of 5 culturally diverse students (two 4th, two 6th, and one 8th grader) with learning disabilities. The students were trained on summarization skills in introductory and instructional sessions. Reading comprehension was assessed using 10-item multiple-choice tests at baseline, group reading, independent reading, and follow-up. At each test time, the students substantially improved in reading comprehension and their improvement was maintained in the follow-up test, which was conducted 4 weeks after the instruction was terminated.

For assessment of reading comprehension, Bean and Steenwyk (1984) employed the Nelson Reading Test (Nelson, 1962), Form A, a standardized test. The test contained 75 multiple-choice items that reflect understanding of main ideas and details at the

paragraph level. The questions addressed explicit and inferential information. Sixty 6th graders participated and were randomly assigned to two experimental groups (rule-governed summarization and intuitive approach to summarization) and a control group. Comprehension scores of students in the experimental groups were significantly higher than those of the control group. The difference between the two experimental groups was not significant.

While, generally, one type of comprehension test was employed in summarization studies, Wood et al. (1995) used four types of comprehension tests: free recall, short answer questions, multiple-choice questions, and true-false questions. Summary training groups did not outperform the control group on the reading comprehension measures. Interestingly, however, Wood et al. investigated whether cognitive processes involved in summarization affects encoding. Wood et al. administered all students in training and control groups the free recall test before they wrote summaries. The training groups did not significantly differ from the control group on the free recall, so Wood et al. concluded that students use the cognitive processes while they summarize, not as they read.

Multiple-choice questions, as a primary measure of reading comprehension, were typically generated by researchers (Gajria & Salvia, 1992; Nelson & Smith, 1992; Wood et al., 1995). Researcher-generated multiple-choice questions, however, do not meet desirable validity and reliability of measurement, so generalization of findings is likely to be limited. Use of standardized comprehension tests, as seen in Gajria and Salvia (1992) and Bean and Steenwyk (1984), are an alternative to increase validity and reliability.

Recall. Recall was less frequently employed as a comprehension measure than multiple-choice tests in summarization studies. Armbruster et al. (1987) used an essay

test with a question and a 10-item short-answer test. The essay question addressed the higher-order structure of the problem-solution frame, such as problem, action, and results and assessed how much information related to the higher-order structure students could recall. The short-answer questions were designed to assess recall of specific information in a given passage. Eighty 5th graders without reading disabilities were randomly assigned to either structure- or traditional-training group. The experimental group was trained to recognize the problem-solution structure and to summarize a passage written in problem/solution structure. The control group asked questions and discussed answers after reading. The structure-training group recalled more main ideas in a problem/solution passage than the traditional training group. No difference was found in recall of more specific information on the short-answer questions between the training groups.

Summarization training was also found to be effective in improving undergraduate French learners' ability to comprehend expository texts written in French (Cordero-Ponce, 2000). The French learners were taught summarization rules: get rid of unnecessary detail, use topic sentences, collapse paragraphs, and polish the summary. In a recall test, students were requested to write whatever they remembered from the passage they read with the passage unavailable during pretest, immediate posttest, and 3-week delayed posttest. Students' free recalls were scored for the total number of ideas. The experimental group performed significantly better on the immediate posttest than the control group but a significant difference was not found on the delayed posttest. The total number of recalled idea units of the control group significantly decreased over pretest, immediate posttest, and delayed test. Compared to the control group, the experimental group included significantly fewer extraneous ideas (i.e., idea units that did not appear in

the original passages). Cordero-Ponce interpreted the lack of extraneous ideas as indicating that the experimental group engaged in less distortion of the meaning of the original passage than the control group.

Rinehart et al. (1986) recruited 70 sixth graders to determine if they would improve as a result of summarization training. The students were randomly assigned to an experimental group and a control group. Based on the Gates-MacGinitie Reading test (Gates & MacGinitie, 1989), students in both groups were equal in comprehension prior to training. The experimental group received summarization training using two instructional principles: direct instruction and self-control. The control group did readings and worksheets from sixth-grade basal readers as usual. The dependent variables measured were studying and reading behaviors. Studying measures involved quality of notes, studying time, and recall of major and minor information. Reading measures included outlining and summary writing. In the recall test, eight questions covering major information and six questions tapping minor questions were randomly arranged. The students in the experimental group recalled significantly more major information but not minor information.

Besides multiple-choice questions, Wood et al. (1995) used free recall to evaluate students' improvement in reading comprehension. Students wrote whatever they could remember about the last three paragraphs of a given passage in 5 minutes. Five judges determined main ideas of the passage and students' free recall protocols were given three different scores based on the judges' evaluations. Students' protocols were given one point for each main idea that they recalled. Ideas that were not important but were drawn from the passage and relevant to the free recall question were awarded one point.

Intrusive ideas, which were not drawn from the last three paragraphs, but were correct main ideas in the preceding paragraphs, were given one point. No significant difference was found across different conditions.

The recall tests used in summarization studies largely take two forms: free and confined recalls. In free recall tests, students write as much as they could recall about given passages (Cordero-Ponce, 2000; Wood et al., 1995). Confined recall means that students' recall is constrained to answer given questions (Armbruster et al., 1987; Rinehart et al., 1986). While recall of main ideas was primarily different between experimental and control groups, recall of details hardly differed between both groups (Armbruster et al., 1987; Rinehart et al., 1986). Summarization training appears to contribute to improving reading comprehension by enhancing students' memory of main ideas.

In review of the literature, the experimental groups mostly outperformed the control groups on reading comprehension, which was measured using multiple-choice and recall tests. The better performance of the experimental groups was also found in summarization. Summarization was assessed by evaluating summary products in terms of quantitative and qualitative aspects. The aspects on which written summaries were assessed are described in the following section.

Sentence recognition test. Multiple-choice and recall are two typical reading comprehension assessments that have been used in summarization intervention studies. Researchers developed multiple-choice tests to evaluate the difference in student performance (Gajria & Salvia, 1992; Nelson & Smith, 1992; Wood et al., 1995), as a consequence of an instructional change, although researcher-developed tests are

vulnerable in terms of reliability and validity. In contrast, standardized comprehension tests are more reliable and valid and provide comparative information based on standardized norms. Standardized tests, however, do not sensitively reflect the change in instruction (Valencia, 2000).

Comprehension measures such as multiple-choice and short-answer questions were mostly designed to assess memory of the text. The results of these memory tests, thus, do not reflect understanding of and learning from the text. Remembering a text is necessary for understanding of and learning from the text (Kintsch, 1994) but understanding and learning is beyond memory of the text. Kintsch identified three levels of comprehension: surface, textbase, and situation. In the surface level, words and phrases in the text are reproduced (Kintsch, 1994; Schmalhofer & Glavanov, 1986). The textbase comprehension is to cognitively represent “the meaning of a particular text and its gist” (Schmalhofer & Glavanov, 1986, p.280) by encoding semantic and rhetoric structure of the text. In the situation level, readers integrate the text information with their prior knowledge relevant to the text information.

To examine how text information is represented at the surface, textbase, and situational levels, a sentence recognition task was used (Mannes & Kintsch, 1987; Schmalhofer & Glavanov, 1986). Test sentences were composed of original text sentences, paraphrases, inferences, and distractors. Original, paraphrase, and inference test sentences reflects text comprehension at surface, textbase, and situational levels, respectively. Royer (2001) also used a sentence verification technique to assess reading comprehension. Royer’s test sentences consisted of original, paraphrase, meaning-change, and distractor sentences. Unlike Mannes and Kintsch and Schmalhofer and

Glavanor, Royer's sentence verification technique did not include inference test sentences.

Beyond memorizing exact words and phrases, at the textbase comprehension, readers construct a meaning from a passage and preserve the meaning. Situational comprehension is evident when readers can use the information given in the text into a novel situation (Kintsch, 1994). Paraphrase and inference test sentences are used to assess competencies in constructing a meaning from a passage and learning from the passage.

Assessment of written summaries. Written summaries were evaluated in terms of inclusion of important ideas, use of summarization rules, and synthesis of information. Inclusion of important ideas is a primary category used to assess written summaries. Nelson and Smith (1992) assessed students' summaries in terms of completeness, which refers to the percentage of important information included in a summary. A clinic teacher and a researcher identified important information that should be present in a complete summary. Completeness was presented in percentages that were produced by dividing the number of important ideas addressed in a student summary by the total number of important ideas that the clinic teacher and researcher predetermined. In Armbruster et al.'s (1987) study, students' summaries were parsed into idea units and each unit was scored by its relative importance from 1, the most important idea unit, to 4, the least important idea unit. Counting the number of main ideas in students' summaries is prevalent in other studies (Bean & Steenwyk, 1984; Cordero-Ponce, 2000; Hare & Borchardt, 1984; Wood et al., 1995). Efficiency of summarization was another index to present inclusion of main ideas. Efficiency referred to the proportion of main idea units versus the total words in a summary (Cordero-Ponce, 2000; Hare & Borchardt, 1984).

With regard to identification of important information, Armbruster et al. also examined inclusion of extraneous information across experimental and control groups. Extraneous information is ideas that are not present in the original passage but appear in written summaries.

Use of summarization rules is another aspect on which to assess summary products. Use of summarization rules is verified by counting all instances when summarization rules are employed in a summary (Cordero-Ponce, 2000; Wood et al., 1995). Hare and Borchardt (1984) evaluated the use of five summarization rules: collapse lists, use topic sentences, get rid of unnecessary detail, collapse paragraphs, and polish the summary. Day (1986) also evaluated the effect of summarization training in terms of application of summarization rules: deletion of unimportant and redundant information, superordination, and selection or invention of topic sentences.

Armbruster et al. (1987) assessed quality of writing in four aspects: focus, support, organization, and integration. The focus score reveals how clearly subjects and main points are addressed. The support score reflects how well and how much information in a summary is supported. The organization score indexes “use of structure, transitions, and logic in the piece” (p. 339). The integration score reflects “the overall development and integration of the features” (p. 339).

Inclusion of extraneous information was examined by counting all instances of extraneous idea units in a written summary (Armbruster et al., 1987). Students in the structure training group tended to include more extraneous idea units than the traditional group, especially when the text was not available. The experimental students, who were trained to summarize problem/solution passages, made up extraneous information to fit

into the problem/solution frame when they did not understand or remember the content of the text.

Summary

Summarization is known as a promising comprehension strategy but was not widely used for primary grades (Stahl, 2004). One reason is that elementary students' performance on judgment of importance, integration of idea units, and selection or construction of topic sentences was worse than students in middle school or above (Brown & Smiley, 1977; Brown & Day, 1983; Hidi & Anderson, 1986; Taylor, 1986). Jenkins et al. (1987) and Nelson and Smith (1992), however, revealed that third to fifth graders substantially improved on reading comprehension and identification of important information as a consequence of receiving summarization training. Age level, therefore, is not an obstacle to the teaching of summarization to primary graders.

Direct instruction has been a primary instructional approach whereby summarization was taught (Armbruster et al., 1987; Friend, 2001; Hare & Borchardt, 1984; Rinehart et al., 1986; Rogevich & Perin, 2008) but it results in learner's passivity and impedes peer interaction. Collaborative summarization, an alternative to direct instruction, is focused on scaffolded assistance (Stone, 2002) and enhancement of interaction with and among students (Maloch, 2002). The impact of summarization instruction was assessed on reading comprehension and summarization task (Armbruster et al., 1987; Cordero-Ponce, 2000; Gajria & Salvia, 1992; Hare & Borchardt, 1984; Nelson & Smith, 1992; Rogevich & Perin, 2008). A sentence verification technique was developed to assess understanding of and learning from the text (Royer, 2001;

Schmalhofer & Glavanov, 1986). Particularly, paraphrase and inference test statements reflect deep understanding of text (Mannes & Kintsch, 1987; Schmalhofer & Glavanov, 1986). Written summaries were primarily examined for identification of important information and writing quality of summaries was examined in Armbruster et al.'s study.

The review of literature provided foundational information on which the purpose of this study and the research hypotheses and question were generated. Participants, instructional approaches, and dependent measures were determined based on the review. The following research hypotheses reflect what this study focuses on.

Research Hypotheses

Collaborative summarization (CS), as an alternative to direct instruction (DI), was developed to investigate how Korean fourth graders' performance on reading comprehension and written summarization changes as a function of CS. The CS and DI groups were also compared to the control group to investigate how summarization training affects fourth graders' performance on the dependent measures. The following hypotheses reflect the researcher's predictions of the effectiveness of each instructional approach on reading comprehension, identification of main ideas, writing quality, and inclusion of extraneous information.

1. The CS group will perform significantly better than the DI and control groups on reading comprehension and written summarization (i.e., identification of important information, writing quality, and inclusion of extraneous information) on the posttest and the performance of the CS group on the follow-up test will be comparable to their posttest scores.
2. The DI group will perform significantly better than the control group on reading comprehension and written summarization (i.e., identification of important information, writing quality, and inclusion of extraneous information) on the posttest, but their performance will significantly decline on the follow-up test.

Summarization is a skill that contributes to improving reading comprehension (Armbruster et al., 1987; Cordero-Ponce, 2000; Gajria & Salvia, 1992; Nelson & Smith, 1992; Rinehart et al., 1986), identification of main ideas (Armbruster et al., 1987; Bean & Steenwyk, 1984; Cordero-Ponce, 2000; Hare & Borchardt, 1984; Nelson & Smith, 1992), and writing quality (Armbruster et al., 1987). According to the previous research, learning to summarize via CS and DI is expected to improve the performance on the three dependent measures in comparison to the control group. The CS group will develop summarization skills as they are prompted to produce oral summaries in each instruction session. During oral summarization, the CS group will make a sense of identifying and integrating important idea units and constructing a meaning from the text over time. Through interactions with instructors and peers, the CS group may be able to articulate their summarization skills and understanding of the text. In contrast, the DI group practices a summarization rule in a session and all summarization rules are incorporated while producing written summaries at the final phase. The DI group, thus, is likely to learn summarization rules, rather than summarization. With attention to learning each summarization rule by rote, the DI group may not get facile with incorporation of the rules to write summaries, so their performance on reading comprehension, identification of main ideas, and writing quality may not develop as much as the CS group.

When the CS and DI groups learn to summarize, they are likely to incorporate important idea units in a logical order and the summaries should be concise. Conversely, the control group's summaries may include more unimportant idea units and even extraneous idea units. Summarization skills help to enhance text memory (Kintsch & van

Dijk, 1978), so the CS and DI groups' summaries will include less extraneous information than the control group.

Research Question

The primary focus of the study is on examining the effects of the instructional approach on the four dependent measures: sentence recognition test, identification of important information, inclusion of extraneous information, and writing quality. The effects of the different instructional approaches will be assessed across three points in time: pretest, immediate posttest, and delayed posttest. The following research questions will be investigated.

- What is the relationship between reading comprehension and written summarization (i.e., identification of important information, inclusion of extraneous ideas, and writing quality) as a function of instructional interventions (collaborative summarization, direct instruction, and control) across test times (pretest, immediate posttest, and delayed posttest)?

Chapter III

Method

Setting

The study took place in a public elementary school in Seoul, Korea. There are 539 public and 39 private elementary schools in Seoul, which are supervised by 11 District Education Offices under the control of Seoul Metropolitan Office of Education. A convenient sample of two elementary schools, one for the pilot and another for the primary study, were selected from a district, whose residents rank in the middle in terms of socio-economic class. The principals of the two schools reported, however, that the socio-economic class ranked slightly below average.

Currently, Korean students in grades 4-9 receive nationwide diagnostic tests for language arts, social studies, math, science, and English every year and, additionally, sixth, ninth, and tenth graders take nationwide academic achievement tests in these five subject domains. The diagnostic test results are reported to individual students and the academic achievement test results are released to each district education office and school. Although the nationwide tests are intended to identify students who struggle with each subject domain and provide educational services for them, principals and teachers are aware that they may be evaluated according to the test results. As a consequence, schooling is likely to aim at performing well on the nationwide tests. In this vein, principals and teachers were reluctant to allocate instructional time to the study.

Pilot Study

The newly designed instructional approach, CS, was piloted to check its feasibility. Fourth-grade teachers were reluctant to get involved in the pilot due to their concern of loss of instructional time. One fourth-grade teacher, however, consented to participate in the pilot. The researcher, then, met with the school principal to provide a brief presentation of the study and, then, visited the teacher's classroom to explain to the students how summarization skills contributed to improving reading comprehension of informational text. The researcher distributed parent consent letters and 21 of 24 students agreed to participate. The three students without parental consent were separately seated and given individual work. This fourth-grade class was located in the same district where the primary study took place.

The 21 students were split into three small groups. Each group was composed of seven students with various reading abilities based on the teacher's references and students' performance on a school-wide diagnostic test of reading. When the researcher taught one group, the other groups were given individual work. The classroom teacher helped to supervise the students completing individual work while the researcher worked with groups.

A regular class period was 40 min. In addition to the regular class period, 5 min out of 10 min break time was spent on instruction. The researcher spent an average of 15 min with each group implementing CS, so three groups of students could engage in instruction in every class period. The pilot intervention was provided twice a week. Six science passages were used as instructional materials (see Appendix I). The readability level of the passages ranged from 9 to 12 years by the noun frequency method (Elley &

Croft, 1989). During the pilot, one intervention session was videotaped per class period so that the researcher could check if the instruction reflected the critical features of the CS model. To ensure integrity of the intervention procedures, the researcher also read the checklist of teacher moves in CS model prior to intervention and, following each session, the researcher marked the checklist.

The pilot started at the fourth week of the new academic year of 2009. During the initial two sessions, students were hesitant to engage in group discussions and I was awkward at providing responsive assistance. As I worked with three groups in each class period, I became used to engaging students in summarization activities and varying the level of prompts. At the third week of pilot, I became facile at involving students and using prompts across different levels. As students became familiar with the researcher and the mode of instruction, they responded to peers as well as the researcher when they generated oral summaries in groups. Although the primary interactions took place with the researcher, the frequency of peer interactions increased over time. At the fifth session, for instance, students collaboratively completed an oral summary in response to the researcher-provided prompt. The pilot ended as students constructed individual written summaries at the sixth session.

Participants

An experimental study was performed to investigate how direct instruction, collaborative summarization, and control condition affect reading comprehension and written summarization skills. The researcher personally contacted former colleagues and briefly presented the study to them so that they could understand requirements for

participants. The colleagues contacted fourth-grade teachers who were close to them and might be interested in the pilot and informed the researcher of interested teachers. The researcher, then, individually met with the teachers and presented the rationale for the study to them. While the pilot study was in progress, the researcher recruited participants for the experimental study. Three fourth-grade classes in the same school were needed in order to ensure equality of socio-economic status and to make random assignment of students to treatment conditions. Recruitment for the experimental study started with contacting principals. The researcher received references to principals from a colleague and individually met each principal. In the meeting with principals, the researcher provided an overview of the study. Once the principal agreed to the conduct of the study in the school, he or she introduced the researcher to chief fourth-grade teachers. The researcher presented the rationale of the study to the chief fourth-grade teachers and the chief teachers contacted their coworkers. When at least three teachers exhibited interest in the study, the chief teachers referred the researcher to the interested fourth-grade teachers. The researcher introduced the fourth-grade teachers to the benefits of learning summarization, requirements, and instruction and testing procedures. In one school, three fourth-grade teachers wanted their students to learn summarization but they were reluctant to get involved in the study as intervention providers. Instead of training classroom teachers, the researcher and a colleague became intervention providers.

The three classes consisted of 25, 27, and 27 students, respectively. The researcher visited the three teachers' classrooms and briefly presented how participation in the study would help to improve their reading. Following presentation, the researcher distributed parent permission letters to their students. Parents of all students in the three

classrooms consented to their children's participation in the study. The researcher ranked students in each classroom by their reading scores on the Diagnostic Tests for Basic Skills of Elementary Students (DTBS) (KICE, 2009) by gender. Three students, one from each classroom, were matched by reading score and gender and randomly assigned to direct instruction (DI), collaborative summarization (CS), or control instruction. The number of students whose performance on the DTBS was two standard deviations below the mean score was one, one, and three in the CS, DI, and control groups, respectively.

Table 1

Distribution of Participants by Instructional Condition and Gender

Class	CS		DI		Control		Total	
	Boy	Girl	Boy	Girl	Boy	Girl	Boy	Girl
1	5	4	5	4	4	5	14	13
2	5	4	5	5	4	4	14	13
3	4	4	4	4	5	4	13	12
Total	14	12	14	13	13	13	42	37

Note. CS = Collaborative summarization, DI = Direct instruction, Control = Control group.

One student, each in the CS and DI groups, missed one intervention session during the week when instruction was provided. Two students in the control group missed the posttest and the follow-up test, respectively. Data of these four students were excluded from analysis. Data from 25, 26, and 24 students, each in the CS, DI, and control groups, were included in the final analysis.

Reading Materials

The reading materials for instruction and testing were chosen based on the following criteria. First, the content of the passages must be interesting and informative. Second, the content must be comprehensible without background knowledge of a particular culture. If a passage contains cultural content, the passage must include all of the information that novices need to understand the passage. Third, the content must be consistent with children's intellectual, emotional, and language development.

Instructional passages. Informational passages on science and social studies were selected from the fourth-grade reading textbook (Ministry of Education, Science, & Technology, 2008). Given that one passage was used per session, a total of six informational passages were needed. Table 2 presents the informational passages that were used in each session. The content of each passage was self-contained and, therefore, did not require additional information to be understood. The same passages were used across the three conditions. These six passages had not yet been used in class instruction.

Table 2

Title of Instructional Passages, Relevant Domains, and Number of Sentences (Paragraphs) by Session

Session	Title	Relevant domain	Length
1	The end of hibernation (경칩)	Social studies/science	12 (3)
2	Traditional clayware (우리의 질그릇)	Social studies/science	13 (6)
3	A game of Yut (윷놀이)	Social studies	14 (3)
4	Korean wrestling (씨름)	Social studies	16 (5)
5	Growth pain (성장통)	Science	13 (4)
6	Salt (소금)	Social studies/science	22 (6)

Test materials. Three reading comprehension tests were developed. Each test included four informational passages of 12 or more sentences. One passage was at the readability level of 9-10, two passages at 9.5-10.5, and one passage at 10-12. The readability level of passages was rated by the noun frequency method (Elley & Croft, 1989).

Table 3

Title, Readability Level, and Source of Testing Passages by Test Time

Test time	Readability level	Title	Source
Pretest	9-10	Do other animals sweat?	National Geographic Explorer
	9.5-10.5	Ocean dwellers disappearing	Teacher Created Resources
	9.5-10.5	Gravity: The invisible force	Teacher Created Resources
	10-12	Animal communication	Steck-Vaughn
Posttest	9-10	Tap into sap	Rigby
	9.5-10.5	Boa constrictor	abcteach.com
	9.5-10.5	Your genes	Teacher Created Resources
	10-12	Making energy from the moon	Teacher Created Resources
Follow-up test	9-10	Skin and bones	Teacher Created Resources
	9.5-10.5	Wiggling worms	Teacher Created Materials
	9.5-10.5	Amphibian or reptile?	National Geographic Explorer
	10-12	What causes hiccups?	Teacher Created Resources

Note: Readability levels were determined by the noun frequency method (Elley & Croft, 1989).

For the written summarization tests, a passage of 9.5-10.5 readability level was used. The testing passages are presented in Table 3. The researcher translated the passages from English into Korean. A Korean colleague, with a doctorate in special education, reviewed the original and translated passages. The researcher and colleague revised the draft translations together and asked three elementary teachers to check whether the test passages used appropriate vocabulary and made sense. The three

elementary teachers also examined the content of the 12 test passages and they concurred that the content of the passages was appropriate for fourth graders. The final version incorporated these teachers' feedback.

Measures

Two dependent variables, reading comprehension and written summarization, were measured across the three different instruction conditions at pretest, posttest, and follow-up test. Reading comprehension was assessed to measure whether students can construct a meaning from text and integrate the content of the text with their relevant prior knowledge. Written summarization was examined for identification of main ideas, writing quality, and inclusion of extraneous information. Informational passages, comparable in readability and length and not used for instruction, were used for testing.

Reading comprehension. To capture student improvement in reading comprehension as a function of intervention, the researcher developed three equivalent reading comprehension tests using a sentence verification technique. Sentence verification technique is a procedure by which tests are developed to assess students' performance in constructing meaning from a passage and preserving the meaning, rather than memorizing exact words (Royer, 2001). Mannes and Kintsch (1987) and Schmalhofer and Glavanov (1986) also used a sentence recognition task to develop reading comprehension tests but, unlike Royer, they included inference test sentences to assess how readers integrate the content of a passage with their relevant prior knowledge.

Rather than measuring text memory, the study focused on assessing how students construct the meaning of text and integrate information in the text with their prior

knowledge. For this reason, paraphrase and inference test sentences were developed. A paraphrase statement is a sentence whose words are changed to the maximum extent but in which the meaning of the original sentence is retained. An inference statement is a sentence that does not appear in the passage but can be inferred based on understanding the content addressed in the passage.

Twelve passages of 12-27 sentences were used to develop three comprehension tests following Mannes and Kintsch (1987) and Schmalhofer and Glavanov (1986). Given that the reliabilities of sentence recognition tests range .5 to .6 with three test passages of 16 test statements (48 statements) and .7 to .8 with four test passages of 16 test statements (64 statements) (Royer, 2001), the sentence recognition tests in this study may range from .6 to .7 because 56 test statements were generated from four passages, 16 for two passages and 12 for the other two passages,.

Three elementary teachers and the researcher collaborated to generate sentence verification sentences. The four developers independently generated possible paraphrase and inference sentences to the maximum extent based on the original passages. The researcher and teachers incorporated the generated sentences into three comprehension tests of 28 paraphrase and 28 inference statements. Half of the verification statements were affirmative sentences and the other half were negative. The affirmative and negative test sentences were randomly mingled. Students marked yes if test sentences mean the same things as the sentences in the original passage and *no* if sentences have different meanings than the sentences in the passage. Raw scores were determined by counting the number of problems that were correctly answered.

Summarization. Students were asked to write summaries of a testing passage at the readability level of 9.5-10.5 in pretest, posttest, and follow-up test. Students were told to produce summaries using all applicable summarization skills that they learned or knew. Students could not look back at the passage that they were going to summarize.

Written summaries were evaluated in terms of identification of important information (Armbruster et al., 1987; Bean & Steenwyk, 1984; Cordero-Ponce, 2000; Hare & Borchardt, 1984; Nelson & Smith, 1992; Wood et al., 1995), inclusion of extraneous information (Armbruster et al., 1987), and quality of writing (Armbruster et al., 1987). Identification of important information was assessed by counting the scores that were assigned to each idea unit in written summaries by its importance to the themes of the passages. The test passages were broken down into idea units, which are independent clauses (Armbruster et al., 1987). The researcher and a Korean colleague, who has 5 years of teaching experience in Korean elementary schools and is in a doctoral program of elementary science education in U.S.A., independently parsed the three test passages into independent idea units. Interrater agreement was 96%, 97%, and 97%, respectively, for the pretest, posttest, and follow-up test passages. Interrater reliability was computed by applying the point-by-point formula (Kazdin, 1982). When disagreement occurred, final decisions were made through discussion between the researcher and Korean colleague.

The researcher and two Korean colleagues, who have 5 and 7 years of teaching experience, respectively, rated the importance level of each idea unit in the three test passages. The individual raters gave 3 for idea units that were most important to the themes of the passages, 2 for idea units that were moderately important, and 1 for idea

units including unimportant information (Hare & Borchardt, 1984). The idea units that were scored as 3 by all three raters were determined as main ideas (Hare & Borchardt, 1984). Main ideas do not necessarily mean topic sentences (Hare & Borchardt, 1984). The idea units that were scored as 1 by all three raters were counted as unimportant ideas. The other idea units were rated as 2.

Students' summaries were scored according to the rating scale. When the same main ideas were written in students' summaries twice or more, only first mentioned main ideas were counted as important information and repeated main ideas were considered unimportant information (Hare & Borchardt, 1984). Repeatedly written unimportant ideas were counted as unimportant information. Extraneous idea units in student summaries were counted for comparison across the three intervention groups (see Appendix A for the criteria for grading written summaries).

Quality of writing was evaluated in terms of three indexes that Armbruster et al. (1987) employed: focus, support, and organization. The three indexes are derived from the Rating Guide for Functional Writing developed by Illinois State Board of Education. The indexes are still used in the current ISAT writing assessment rubric (Illinois State Board of Education, n.d.). In the ISAT writing rubric, each index is rated as 1 (lowest) to 6 (highest). In this study, however, the six-point scale is reduced into a three-point scale to ensure the reliability of rating (see Appendix B). The three index scores were summed into a single score of quality.

Two raters scored written summaries in terms of the number of important and extraneous idea units and writing quality. To compute interrater reliability, they independently graded 30 summaries that were randomly selected and compared

agreement on the number of important and extraneous ideas and writing quality.

Applying the point-by-point formula (Kazdin, 1982), the two raters reached 95% of agreement on identification of important information, 99% on inclusion of extraneous information, and 97 % on writing quality.

Procedures

Training intervention provider. A Korean colleague, with a doctoral degree in special education, was trained in CS and DI. The researcher introduced the colleague to the rationale, features, and procedures of each instructional approach. Opportunities for roleplay were also included in the training sessions. Three sessions of 40 to 60 min were offered to train the colleague in each instructional approach.

The colleague was oriented to the features of the CS approach such as teacher's roles, levels of responsive assistance, conversational skills, and the instructional procedures. Video clips that were produced during the pilot study were viewed and the researcher and colleague discussed examples of interactions that represented the CS approach. During roleplay, the colleague practiced conducting CS instruction.

In regard to DI, summarization rules, features of DI, and the instructional steps, which Rosenshine (1983) generated, were introduced. The researcher demonstrated how to employ each summarization rule across the steps and the colleague practiced each rule in isolation. Once all summarization rules were learned, the colleague individually wrote a summary combining all the rules. The colleague also played a teacher's role by simulating the researcher as a student. For the control group, the researcher described the typical form of reading instruction and requested the teachers to follow the format.

To ensure that the colleague followed the format of each approach, the researcher provided a checklist that displayed key elements that should be implemented. The researcher asked the colleague to read it through prior to beginning each session and to check if he observed the criteria following each session. The following section explains the instructional procedures that pertain to each intervention condition.

Instructional procedures. The fourth graders were randomly assigned to DI, CS, or control instruction and they moved to one of the three classrooms according to the assigned condition. The students stayed in their assigned classrooms for two consecutive class periods. One class period was spent for intervention and another class period was for regular reading lesson by fourth-grade teachers. One of the two experimental groups received intervention in the first class period with the other group in the second class period. While the two instructors taught summarization to one experimental group, the other experimental group received a regular reading lesson from a fourth-grade teacher whose students participated in the study. The order of receiving intervention was counterbalanced between the two experimental groups. The teacher in the control condition spent 20 min working on one instructional passage in a traditional instruction format during the first class period. For the rest of class period, the control students completed independent work. During the second class period, the students received a regular reading lesson from the teacher. The experimental study lasted for six consecutive days.

The researcher and colleague taught summarization using two different approaches. One day, the researcher and colleague started with CS but, next day, DI. The experimental groups were split into four small groups of 6 to 7 students and the control

students were taught as a whole class. In the two experimental conditions, the two intervention providers spent an average of 20 min with each group so that all students could receive instruction in one class period.

Direct instruction. Hare and Borchardt's (1984) five summarization rules, *get rid of unnecessary detail*, *collapse lists*, *collapse paragraphs*, *use topic sentences*, and *polishing the summary*, were reduced to four rules by combining *collapse lists* and *collapse paragraphs* into a single *collapse* rule because both rules are commonly associated with making a concise summary. One rule was taught in a 20 min session. A rule was introduced with instructor's demonstration of using a rule, followed by guided practice and independent practice. While *get rid of unnecessary detail*, *collapse*, and *use topic sentences* were instructed over the first three sessions, the *polishing the summary* rule was taught for two sessions. In the sixth session, the four rules were reviewed and students were asked to write a summary using all four rules.

In the first session, the instructors provided the rationale for learning summarization with regard to its contribution to improving reading comprehension. The instructors first introduced *get rid of unnecessary detail*. After the instructors asked students to silently read a passage, they demonstrated crossing out unimportant, trivial, and redundant information in a paragraph of the passage. Following the demonstration, the instructors and students crossed out unimportant, trivial, and redundant information in the following paragraph of the passage. As the instructors encouraged students to look for unnecessary information, they pointed out errors that students made and corrected the errors with explanations. When students encountered unfamiliar words, the instructors explained their meanings. Following guided practice, students individually practiced

deleting unnecessary information and selecting important information with the remaining paragraphs of the passage. Students turned their work in so that the instructors reviewed and provided feedback for the work.

In the second session, the instructors reviewed the *get rid of unnecessary detail* rule. After the instructors returned students' work with corrective feedback, they presented common errors that students made in selecting important information and corrected the errors with explanations. Thereafter, *collapse* rule was introduced and demonstrated by the instructors. Guided practice followed instructor demonstration and, then, students independently practiced the *collapse* rule. In session 3, *use topic sentences rule* was taught in the same way that *get rid of unnecessary detail* and *collapse* rules were instructed.

In session 4, the instructors introduced the *polishing the summary*. The purpose of *polishing the summary* rule is to refine summaries. The instructors demonstrated applying *the polishing the summary* rule with a part of a prepared written summary, followed by guided practice with the rest of the summary. In session 5, the instructors elicited group summaries from the students and wrote them down on a white board for all students to see. The students independently practiced polishing the summary using the group summaries. In the sixth session, the instructors gave students a prompt to plan a summary prior to writing a summary and the students independently produced summaries integrating the four summarization rules.

Collaborative summarization. CS is characterized by peer discussion and responsive assistance. Student participation was open during instruction, so students did not have to raise their hands and wait for teacher's nomination unless they interrupted

other speakers. As students were unfamiliar with the format of open participation, the instructors explained the new instructional format by comparing it to the typical participation format that has been used in teacher-led instruction (Clark et al., 2003; Maloch, 2002). To shift from teacher-led to student-interactive instruction, the instructors needed to employ conversational skills by which they engaged students in the process of learning summarization and facilitated social interaction. Table 4 displays probable student moves and relevant teacher responses. The table is modified from Maloch's (2002) examples in accord with summarization instruction.

In initial sessions, students were unwilling to engage in group discussion. The instructors frequently invited students to discussion and reinforced their engagement by acknowledging and praising their involvement. While the instructors led discussions and employed the exemplar responses presented in Table 4 at the beginning, students were encouraged to take over the lead and adopt the teacher moves in discussions over sessions. The instructors did not use interpretative authority and stay silent while students' conversations went on. While student interactions increased, the instructors smoothly faded their roles.

Teacher assistance was contingent on student responses, instead of being offered in a predetermined schedule. The instructors varied the level of assistance according to student performance in summarization. Wood and Middleton (1975) found that children learned better when tutor assistance was adjusted to their current level of performance than when the highest level of help such as modeling continued to be given from the beginning on. When the highest level of help was consistently offered, students seemed to doubt their abilities to carry out the task and their interest in the task decreased. CS

instruction did not start by providing the greatest level of teacher help and end up with the least amount of help (Many, 2002; Wood & Middleton, 1975). Many (2002) and Wood and Middleton (1975) revealed that the greatest level of teacher help such as demonstration was provided when students did not respond well to the least amount of help. Rodgers (2004) also showed that demonstrating and telling, two greatest levels of teacher help, were least used.

Table 4

Teacher Responses to Examples of Student Moves

Student moves	Teacher responses
Students are hesitant in sharing their responses	Invite participation by asking questions ([Name], what is a key idea in the passage?)
A student starts to share a response.	A teacher acknowledges the student's response by (a) asking follow-up questions, (b) restating the statements to check understanding, or (c) thanking the student for sharing
Students look to the teacher for leadership or solutions	Encourage students to look to each other Adjust the level of assistance and prompt them using an appropriate level of assistance
Students respond too briefly without providing reasons or supporting evidence	Ask students to support their responses (How did you figure it out? Why do you think so?, What else do you think is important?)
Students choose wrong information	Ask them to try again (You could try again.) Offer suggestions (Have you thought about...?)
Students do not connect their responses to statements made by others	Ask them to think about others' opinions (What do you think about her/his?)

Note: Modified from the table of teachers' expectations and associated strategies by Maloch (2002), p. 103.

Rodgers (2004) categorized teacher assistance into four levels by the degree of teacher help. Tables C1-C4 in Appendix C present how four levels of teacher help were applied to teach the four summarization rules. Questioning is the most minimal form of teacher assistance. Instead of explicitly teaching the rules, instructors prompted students to recognize summarization components by questioning. Directing is that instructors suggest a specific action for students to take. As students take the action, they engage in summarization. Demonstrating with explanation is that instructors model applying the summarization rules and verbalizes the application process. In the greatest level of support, telling, instructors directly tell what students are supposed to do or say.

As seen in Tables C1-C4, summarization rules were prompted using the four levels of teacher assistance. While, in DI, the summarization rules were taught in a particular sequence, the order whereby summarization rules were introduced varied across groups in CS instruction according to students' current knowledge and understanding of summarization. The instructors assessed student's knowledge and understanding by probing during instruction and determined the level of assistance based on student performance in summarization.

CS instruction was conducted over six sessions. Instruction began with silent reading of an informational passage. The instructors spent 20 min per group so that four groups of students could receive instruction in a class period. The same summarization rules that were taught in DI were instructed in CS but the rules were not explicitly mentioned. The instructors evaluated students' prior knowledge of summarization by questioning what constituted a good summary. The instructors began with the rules that students already had a sense of, rather than teaching the rules in a sequential order.

For about 10-15 min of each session, the instructors prompted students to implement summarization rules with an informational passage by modulating the level of assistance. Mostly, questioning was the initial prompt. By questioning, the instructors probed whether students could execute summarization rules and determined whether they should stay on questioning or advance to the next level of assistance. Unless students responded well to questioning, the instructors suggested specific steps that students would take and assessed their performance. Even though demonstration and telling were the next levels of teacher assistance, students mostly performed well in questioning and directing. Students seemed to notice integral elements of summarization over sessions. For the following 5-10 min in a session, students were promoted to orally summarize the informational passage that they read in collaboration with peers.

With the passage of time, the instructors attempted to fade their lead by sitting outside of the groups to facilitate students to take over teacher roles. During sessions 1-5, students produced oral summaries and they wrote summaries in session 6 to ensure comparability with DI. Students were prompted to plan a summary before they wrote a summary, as given in direct instruction.

Control group. Students in the control group were taught as a whole class. The lesson was conducted following the design of Korean reading textbook. The reading textbook starts with an objective that is intended to be accomplished through the given text (Ministry of Education, Science, & Technology, 2008). The text follows the objective and precedes comprehension questions, which are at the end. Students read a passage in round-robin style and answered comprehension questions that were placed at the end of passage. As the majority of students finished answering the questions, the

teacher read a question out aloud. Students raised their hands to respond and the teacher nominated a few students for each question. Finally, the teacher gave the correct answer. All comprehension questions were checked in the same way.

To ensure the equality with the experimental groups, each session lasted for 20 min. The control students spent the remaining 20 min reading their favorite books that they brought or doing assignment. Every time students left to the assigned classroom, they were reminded to bring books or work for the remaining time.

Fidelity of treatment. The researcher generated a checklist to ensure the fidelity in implementing each intervention. The checklists included key principles and procedures of instruction based on each instructional condition (see Appendix D). Prior to each class, instructors reviewed the checklists and marked the checklists following each session. The first, second, and fifth sessions were videotaped and the researcher reviewed the recorded lessons to check if the instructors followed the principles of each instructional approach. The instructors spent 20 to 30 min discussing their instruction when they finished daily lessons. Reviewing the checklists, the instructors shared instances in which students responded well and challenges they encountered while teaching summarization.

Testing procedures. Testing took place at three points of time. The pretest was administered one week before intervention started. The posttest was conducted one week after the intervention ended. The follow-up test was implemented one month after the intervention was discontinued. The three tests were administered in students' original classrooms by their teachers in their regular reading classes. Students completed the reading comprehension and summarization tests for 50 min as a whole class. When students took the written summarization test, they could read a passage as much as they

needed. After they finished reading it, the reading passage was returned. Students did not look back at the passage when they produced summaries.

Data Analysis

This study was conducted to investigate the performance of two experimental groups of Korean fourth graders relative to that of a comparable control group in terms of reading comprehension and written summarization as a function of instructional interventions. Three types of instruction (i.e., CS, DI, and control) served as a between-subjects variable and three points of test time as a within-subjects variable. Reading comprehension and written summarization are the two dependent variables. The reading comprehension test consisted of paraphrase and inference sentences for which students were required to verify whether the sentences deliver the same meaning as the original passages. Written summarization was composed of three measures: identification of important idea units, inclusion of extraneous ideas, and writing quality. A total of four dependent measures, therefore, were completed by participants at each test time (pretest, posttest, and follow-up test). In the following chapter, the results of repeated measures multivariate analysis of variance through SPSS 13 and subsequent repeated measures univariate analyses will be presented.

Chapter IV

Results

Seventy five students from three fourth-grade classrooms were matched on gender and scores on language arts in the DTBS (KICE, 2009) and randomly assigned to collaborative summarization (25), direct instruction (26), and control condition (24). The effects of the three instructional conditions were examined on reading comprehension, summarization, and writing quality across three test times (pretest, posttest, and follow-up). Reading comprehension was assessed by asking students to verify whether test items deliver the same meaning as the sentences in test passages. Summarization was examined in terms of identifying main ideas and including extraneous information. Writing quality was a combined rating of focus, support, and organization indexes.

Means and standard deviations on reading comprehension, identification of main ideas, inclusion of extraneous information, and writing quality across pretest, posttest, and follow-up test are reported for the three groups in Table 5. The maximum score for each measure is 30 on the DTBS, 56 on reading comprehension, 100 on identification of main ideas, and 9 on writing quality. The number of extraneous idea units in student summaries was counted. Data on the range of scores on reading comprehension, identification of main ideas, writing quality, and inclusion of extraneous information are reported in Table E1 in Appendix E. The effect of the instructional condition across three test times was investigated using repeated measures analysis with instructional condition as a fixed factor and test time as a within- subject factor. Statistical significance was determined by a conventional alpha level of .05.

Table 5

Mean (SD) of Scores on a Diagnostic Test and Four Dependent Measures

Group (n)	DTBS	Reading comprehension			Main ideas			Extraneous information			Writing quality		
		Pret	Post	Followup	Pre	Post	Followup	Pre	Post	Followup	Pre	Post	Followup
CS (25)	27.00	38.56	39.60	39.80	21.50	39.14	13.60	2.72	.72	1.44	5.08	6.32	4.72
	(2.52)	(5.12)	(5.39)	(5.52)	(16.74)	(18.80)	(10.97)	(1.65)	(.89)	(1.71)	(1.66)	(1.35)	(1.46)
DI (26)	26.54	38.92	40.08	41.12	24.52	37.36	22.31	2.08	.58	.62	5.35	6.04	5.62
	(3.02)	(6.61)	(6.03)	(6.66)	(20.76)	(20.93)	(15.99)	(1.60)	(.86)	(.75)	(1.50)	(1.61)	(1.20)
Control (24)	25.96	38.42	38.00	34.13	24.48	26.79	10.28	2.79	1.62	.92	5.29	5.33	4.04
	(3.88)	(3.92)	(6.61)	(6.12)	(18.97)	(15.37)	(9.22)	(2.30)	(1.25)	(1.91)	(1.65)	(1.55)	(1.37)

Note. DTBS= Diagnostic tests for basic skills of elementary students, CS = Collaborative summarization, DI = Direct instruction, Control = Control group.

Group Equivalence

Ensuring equality of groups on relevant variables is prerequisite to accurately capture the effect of an experimental condition. Participants were randomly assigned to the three groups, so they should not differ prior to receiving intervention. The three groups were compared on the DTBS score and pretest scores on reading comprehension, identification of main ideas, inclusion of extraneous information, and writing quality. Analysis of variance for each measure revealed no significant difference across the three groups prior to intervention, as seen in Table F1.

Multivariate Analysis of Dependent Variables

Correlation analysis was completed to determine whether multivariate analysis was needed to examine response patterns on dependent measures as a consequence of an experimental condition. Correlation among reading comprehension, identification of main ideas, inclusion of extraneous information, and writing quality was examined using the pretest scores on the four dependent measures. The Pearson correlation coefficients are reported in Table 6. Correlation among reading comprehension, identification of main ideas, and writing quality was significant ($p < .01$). Inclusion of extraneous information had a negative relationship with the other three variables. The negative correlation between identification of main ideas and inclusion of extraneous information was highly significant.

As seen in Table 6, reading comprehension, identification of main ideas, and writing quality were significantly correlated, supporting the conduct of multivariate analysis with the three dependent measures. In the repeated measures multivariate

analysis, no significant between-subjects effect was found ($F(6, 140) = 1.18, p = .321, \eta_p^2 = .048$). The main effect of time ($F(6, 67) = 11.97, p = .000, \eta_p^2 = .517$) and the time-by-condition interaction effect ($F(12, 134) = 3.35, p = .000, \eta_p^2 = .231$) were significant, therefore additional repeated measures analyses were performed to examine the two within-subjects effects for the three dependent variables.

Table 6

Pearson Correlation Coefficients Among Dependent Variables at Pretest

Measure	Measure			
	1	2	3	4
1. Reading comprehension	1.00			
2. Main ideas	.38**	1.00		
3. Extraneous information	-.17	-.33**	1.00	
4. Writing quality	.44**	.70**	-.12	1.00

Note. ** $p < .01$

Reading Comprehension

The mean reading comprehension scores are depicted across the three test times in Figure 1. In the diagram, the two experimental groups slightly improved across the three test times, while the reading comprehension scores of the control group slightly decreased on the posttest and substantially on the follow-up test versus the pretest. Repeated measures multivariate analysis revealed no significant between-subjects effect, so separate repeated measures univariate analyses were implemented to examine the time and time-by-condition interaction effect on reading comprehension.

In the testing of within-subjects effects, the main effect of time was not significant ($F(2,144) = 1.07, p = .343, \eta_p^2 = .015$), while the time-by-condition interaction was

highly significant ($F(4,144) = 5.86, p = .000, \eta_p^2 = .140$). By conducting separate repeated measures analysis of two groups at a time, groups that contributed to the significant interaction effect were identified. According to the results presented in Table 7, the mean differences between the two experimental and control groups were significant over the three test times.

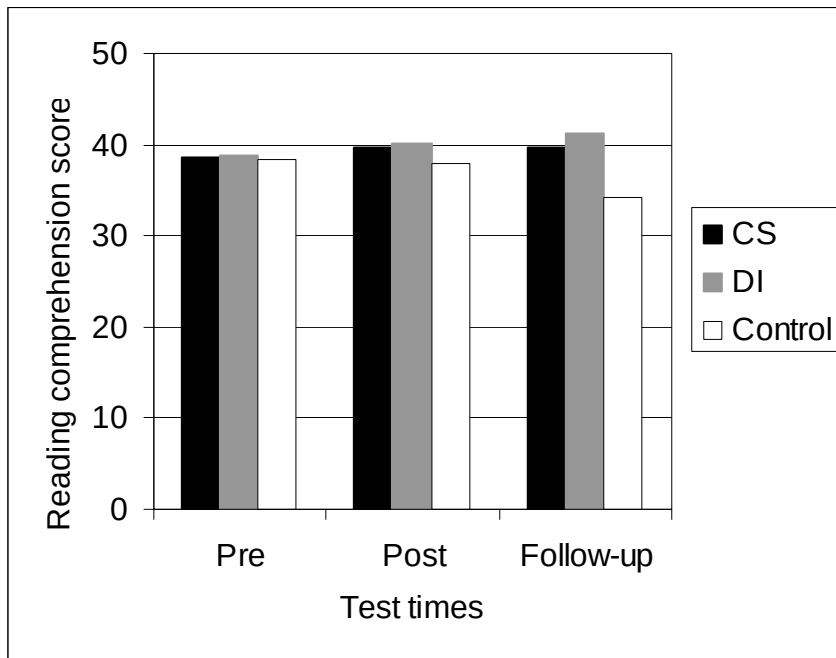


Figure 1. Mean scores on reading comprehension by condition across three test times. (Max=56)

Additional repeated measures analyses were performed involving two test times at once to specify when the significant interaction effect occurred. As reported in Table C1, significant mean differences between the two experimental and control groups were found from posttest to follow-up test. Compared to the slight improvement of CS and DI groups, the mean of the control group significantly decreased from posttest to follow-up test. The control group's mean change from pretest to posttest was significantly greater

than that of CS and DI groups, which reflects a significant decline of the control group on reading comprehension.

Table 7

Repeated Measures Analysis for Time-by-Condition Interaction Effect on Reading Comprehension Between Two Groups

Group	Source	Type III SS	df	MS	F	p
CS-DI	Time×condition	6.90	2	3.45	.26	.770
	Error	1287.30	98	13.14		
CS-control	Time×condition	201.33	2	100.67	6.92	.002**
	Error	1366.98	94	14.54		
DI-control	Time×condition	285.59	2	142.79	10.07	.000***
	Error	1361.27	96	14.18		

Note. CS = Collaborative summarization, DI = Direct instruction, Control = Control group. ** $p < .01$, *** $p < .001$

Identification of Main Ideas

Student summaries were divided into idea units and each idea unit was scored by its importance level of 1 to 3. The three test passages differed in the total number of idea units by importance level, so the number of idea units in student summaries was converted into percentage by importance level. In so doing, comparison across pretest, posttest, and follow-up test was possible. The three groups did not show any significant difference in terms of idea units at levels 1-2. The idea units at levels 1-2, thus, were not additionally analyzed but only idea units at level 3, called main ideas (Hare & Borchardt, 1984) were examined in this section.

The means for identifying main ideas from pretest through follow-up test are displayed in Figure 2. The two experimental groups outperformed the control group on the posttest. The scores of the three groups, however, considerably decreased on the

follow-up test. The mean scores on the follow-up test were lower than those on the pretest and posttest.

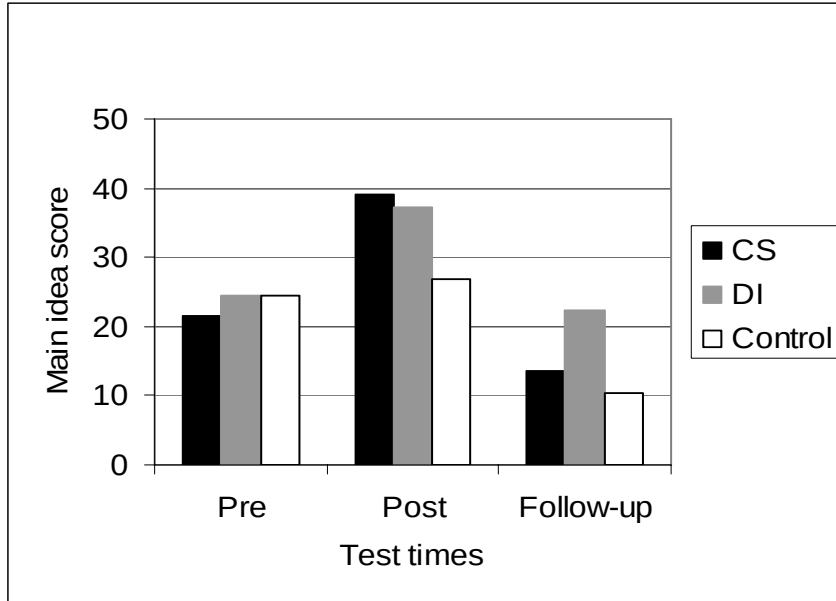


Figure 2. Means of identified main ideas by condition across three test times. (Max=100)

In the testing of within-subjects effects, the main effect of time ($F(2,144) = 31.91$, $p = .000$, $\eta_p^2 = .307$) was highly significant and the time-by-condition interaction effect ($F(4,144) = 2.498$, $p = .045$, $\eta_p^2 = .065$) was also significant. The two within-subjects effects were additionally examined to specify when significant differences occurred over the three test times and which groups contributed to the significant interaction effect. When repeated measures analysis was performed involving two test times at once, the main effect of time was significant in the three cases, as presented in Table 8. The total mean score of the three groups on the posttest was significantly higher versus those on the pretest and follow-up test. Furthermore, the performance on the follow-up test was significantly lower than that on the pretest.

Additional analyses were conducted to examine the variation of mean scores across the three test times for each group. The CS group identified significantly more main ideas on the posttest than on the pretest ($F(1,24) = 23.35, p = .000, \eta_p^2 = .493$), but their mean score on the follow-up test was significantly lower than those on the pretest ($F(1,24) = 5.18, p = .032, \eta_p^2 = .177$) and posttest ($F(1,24) = 62.42, p = .000, \eta_p^2 = .722$). The DI group's mean score on the posttest was significantly higher than that on the pretest ($F(1,25) = 6.71, p = .016, \eta_p^2 = .212$) and their mean score on the follow-up test was significantly lower than that on the posttest ($F(1,25) = 11.53, p = .002, \eta_p^2 = .316$). No significant difference was found between pretest and follow-up test. The control group did not show significant change between pretest and posttest, but their mean score on the follow-up test was significantly lower than those on the pretest ($F(1,23) = 9.30, p = .006, \eta_p^2 = .288$) and the posttest ($F(1,23) = 22.46, p = .000, \eta_p^2 = .494$).

Table 8

Repeated Measures Analysis for Main Effect of Time on Identification of Main Ideas Involving Two Test Times

Test times	Source	Type III SS	df	MS	F	p
Pre-post	Time	4596.62	1	4596.62	18.22	.000***
	Error	18667.09	74	252.26		
Post-followup	Time	13560.13	1	13560.13	73.32	.000***
	Error	13686.47	74	184.95		
Pre-followup	Time	2366.78	1	2366.78	10.22	.002**
	Error	17138.43	74	231.60		

Note. ** $p < .01$, *** $p < .001$

Separate repeated measures analysis for time-by-condition interaction revealed a significant mean difference between the CS and control groups ($F(2,144) = 4.06, p = .020, \eta_p^2 = .080$). To identify when the significant interaction effect occurred for CS

and control groups, repeated measures analysis was used involving two test times. The results of the analysis are reported in Table 9. The increase in mean scores of the CS group from pretest to posttest was significantly greater than that of the control group on identification of main ideas.

Table 9

Repeated Measures Analysis for Time-by-Condition Interaction Effect on Identification of Main Ideas Between CS and Control Groups Involving Two Test Times

Test times	Source	Type III SS	df	MS	F	p
Pre-post	Time×condition	1440.02	1	1440.02	7.37	.009**
	Error	9179.84	47	195.32		
Post-followup	Time×condition	499.77	1	499.11	3.62	.063
	Error	6484.25	47	137.96		
Pre-followup	Time×condition	243.11	1	243.11	1.19	.281
	Error	9601.81	47	204.29		

Note. ** $p < .01$

Writing Quality

The maximum score for writing quality was 9, which is a sum of 3 for focus, 3 for support, and 3 for organization. Variation in writing quality over the three test times is depicted in Figure 3. The two experimental groups outperformed the control group on the posttest. CS group improved to the greatest extent on the posttest but, on the follow-up test, CS group's performance decreased more considerably than that of DI group.

Repeated measures analyses revealed that the main effect of time ($F(2,144) = 16.62, p = .000, \eta_p^2 = .188$) and the time-by-condition interaction effect ($F(4,144) = 3.93, p = .005, \eta_p^2 = .098$) were significant. Results of additional repeated measures analyses for time and time-by-condition interaction effect are presented in Tables 10 and 11,

respectively. As reported in Table 10, the main effect of time was significant in the three cases. The total mean score on the posttest was significantly greater than those on the pretest and follow-up test. The total mean score on the follow-up test was significantly lower than that on the pretest.

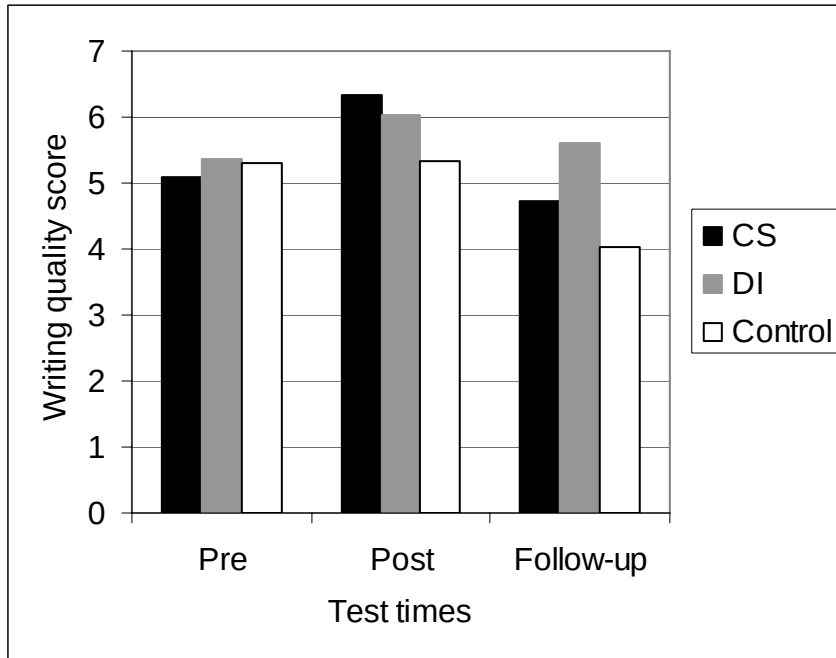


Figure 3. Means of writing quality by instructional condition. (Max=9)

The variation across the three test times was additionally examined for the three groups. The CS group's mean score on the posttest was significantly higher than that on the pretest ($F(1,24) = 17.55, p = .000, \eta_p^2 = .422$), but the mean score on the follow-up test was significantly lower than that on the posttest ($F(1,24) = 32.00, p = .000, \eta_p^2 = .571$). No significant difference was found between pretest and follow-up test. The DI group significantly improved on the posttest ($F(1,25) = 4.75, p = .039, \eta_p^2 = .160$), and their mean score on the follow-up test did not significantly differ from those on the pretest and posttest. For the control group, the mean score on the follow-up test was

significantly lower than those on the pretest ($F(1,23) = 9.97, p = .004, \eta_p^2 = .302$ and posttest ($F(1,23) = 8.45, p = .008, \eta_p^2 = .269$).

Table 10

Repeated Measures Analysis for Main Effect of Time on Writing Quality Involving Two Test Times

Test times	Source	Type III SS	df	MS	F	p
Pre-post	Time	16.22	1	16.22	12.10	.001**
	Error	96.53	72	1.34		
Post-followup	Time	45.73	1	45.73	30.31	.000***
	Error	108.65	72	1.51		
Pre-followup	Time	7.84	1	7.84	5.63	.020*
	Error	95.69	72	1.33		

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

Repeated measures analysis for time-by-condition interaction effect involving two groups revealed significant differences across the three groups, as seen in Table 11. The significant interaction effect across the three groups was further analyzed to identify when the significant interaction effect occurred. The results of repeated measures analysis for mean scores of two groups at two test times are reported in Tables G1 and G2.

The significant mean difference between CS and DI groups was found from posttest to follow-up test ($F(1,49) = 7.98, p = .007, \eta_p^2 = .140$). While the DI group slightly decreased, the CS group declined significantly more in writing quality on the follow-up test. On writing quality, the CS group's performance significantly improved from pretest to posttest and their improvement was significantly higher compared to the control group's stagnancy ($F(1,47) = 6.48, p = .014, \eta_p^2 = .121$). The DI and control groups did not show a significant difference from pretest to posttest and from posttest to

follow-up test. The significant mean difference between the DI and control groups was found from pretest to follow-up test ($F(1,48) = 10.20, p = .002, \eta_p^2 = .175$).

Table 11

Repeated Measures Analysis for Time-by-Condition Interaction Effect on Writing Quality Between Two Groups

Group	Source	Type III SS	df	MS	F	p
CS-DI	Time×condition	8.84	2	4.42	3.92	.023*
	Error	110.44	98	1.13		
CS-control	Time×condition	9.48	2	4.81	3.13	.048*
	Error	142.25	94	1.51		
DI-control	Time×condition	14.50	2	7.25	4.69	.011*
	Error	148.47	96	1.55		

Note. * $p < .05$

Inclusion of Extraneous Information

The extraneous idea units that appeared in student summaries were examined using univariate repeated measures analysis. The descriptive data of extraneous information are reported in Table 12 and the mean scores of the three groups over three test times are represented in Figure 4. The number of extraneous idea units decreased from pretest to posttest across the three groups. Particularly, the number of extraneous idea units of the control group decreased over the three test times.

Based on repeated measures analysis, the between-subjects effect ($F(2,72) = 3.48, p = .036, \eta_p^2 = .088$) and the main effect of time ($F(2,144) = 30.07, p = .000, \eta_p^2 = .295$) were significant but the time-by-condition interaction effect was not significant ($F(4,144) = 1.60, p = .178, \eta_p^2 = .043$). The between-subjects effect was specified by making pairwise comparisons using Tukey's Honestly Significant Differences (HSD). As seen in

Table H1, the DI group included significantly fewer extraneous idea units than the control group ($p < .05$). Separate repeated measures analysis for the main effect of time was performed involving two test times. The total mean score of extraneous idea units on the posttest was significantly lower than that on the pretest ($F(1,72) = 47.32, p = .000, \eta_p^2 = .397$), but there was no significant difference between posttest and follow-up test. Compared to the total mean score on the pretest, that on the follow-up test was significantly lower ($F(1,72) = 33.91, p = .000, \eta_p^2 = .314$).

Table 12

Mean (SD) of Extraneous Idea Units for Three Groups Across Three Test Times

Group (n)	Pretest	Posttest	Follow-up test
CS (25)	2.72 (1.65)	.72 (.89)	1.44 (1.71)
DI (26)	2.08 (1.60)	.58 (.86)	.62 (.75)
Control (24)	2.79 (2.30)	1.62 (1.25)	.92 (1.91)

To examine the significant reduction of extraneous information irrespective of intervention, the number of sentences in students' written summaries were investigated. The results are reported in Table 13. Repeated measures analyses revealed the significant main effect of time between pretest and posttest ($F(1,72) = 8.24, p = .005, \eta_p^2 = .10$) and between pretest and follow-up test ($F(1,72) = 8.64, p = .004, \eta_p^2 = .10$). The total mean scores on the posttest and follow-up test were significantly lower than that on the pretest. The correlation between the number of extraneous idea units and that of sentences approached significance on the posttest ($r = .214, p = .065$) and was significantly high on the follow-up test ($r = .318, p = .005$).

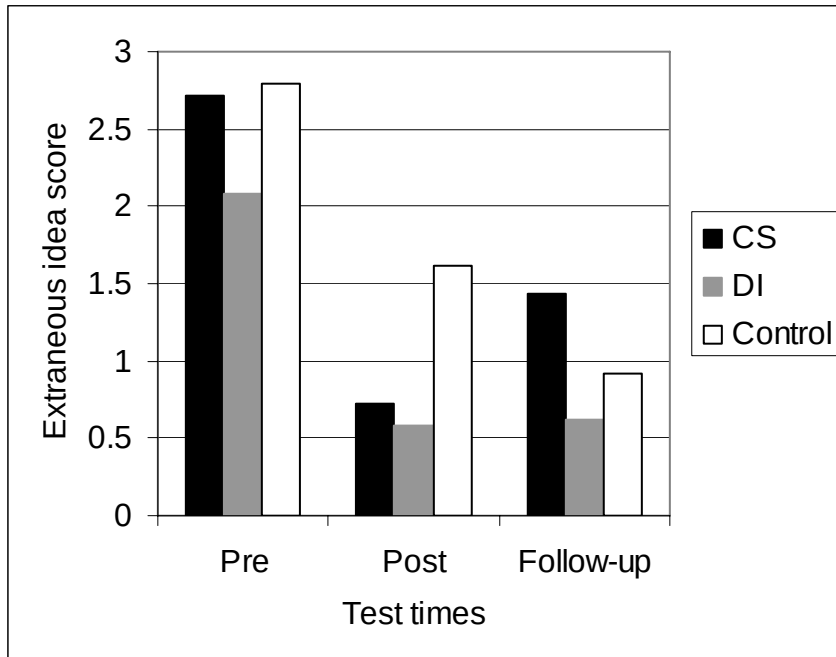


Figure 4. Average numbers of extraneous idea units by instructional condition

Table 13

Mean (SD) of Sentences in Written Summaries for Three Groups Across Three Test Times

Group (n)	Pretest	Posttest	Follow-up test
CS (25)	5.20 (2.72)	4.60 (1.70)	4.60 (2.72)
DI (26)	5.00 (2.32)	4.10 (1.57)	4.30 (1.85)
Control (24)	4.80 (2.52)	3.80 (1.70)	3.30 (1.75)

Students at Risk for Reading Difficulties

Test scores of students at risk for reading difficulties are presented in Table 14. The two students, each in the CS and DI groups, improved on reading comprehension, identification of main ideas, and writing quality, although most of their scores did not reach the total means (RC = 39.25, MI = 34.57, WQ = 5.91) on the three dependent measures on the posttest. The two students' posttest main idea scores are at least twice

higher than their pretest scores. They also slightly improved on reading comprehension and writing quality. The two students at risk for reading difficulties benefited from receiving summarization instruction but they did not maintain summarization skills.

Summary

Significant mean differences from pretest to posttest were not found in the reading comprehension tests among the CS, DI, and control groups, but the mean differences between the two experimental and control groups were significant from posttest to follow-up test. The CS group's mean differences from pretest to posttest on identification of main ideas and writing quality were significantly greater than those of the control group, while the CS and DI groups did not yield significant differences on the two dependent measures. Despite the significant improvement on identification of main ideas and writing quality, the CS group's mean scores on the two measures were not maintained on the follow-up test. All three groups included significantly fewer extraneous idea units in their written summaries on the posttest and follow-up test than on the pretest. The two students at risk for reading difficulties improved on reading comprehension, identification of main ideas, and writing quality, but their scores were not maintained.

Table 14

Scores on a Diagnostic Test and Four Dependent Measures for Students at Risk for Reading Difficulties

S	Group	DTBS	Reading comprehension			Main ideas			Extraneous information			Writing quality		
			Pret	Post	Followup	Pre	Post	Followup	Pre	Post	Followup	Pre	Post	Followup
1	CS	20.00	30.00	34.00	34.00	12.50	28.57	0.00	3.00	0.00	1.00	3.00	5.00	3.00
2	DI	19.00	30.00	36.00	25.00	12.50	50.00	0.00	3.00	2.00	2.00	4.00	5.00	5.00
3	Control	19.00	33.00	28.00	27.00	50.00	28.57	0.00	1.00	2.00	0.00	5.00	6.00	4.00
4	Control	20.00	39.00	25.00	27.00	0.00	7.14	0.00	5.00	3.00	2.00	3.00	3.00	3.00
5	Control	20.00	36.00	42.00	32.00	12.50	28.57	0.00	2.00	1.00	0.00	5.00	5.00	3.00

Note. S = Student, DTBS = Diagnostic tests for basic skills of elementary students, CS = Collaborative summarization, DI = Direct instruction, Control = Control group.

Chapter V

Discussion

The purpose of this study was to investigate how Korean fourth graders' performance on reading comprehension and written summarization changes as a function of instruction in summarization across test times. Although the proportion of Korean students who exhibit reading difficulties is low, those who do struggle with reading comprehension. Reading comprehension becomes more challenging in Korea with the remarkable increase of informational text at third grade. Summarization is one of the promising skills used to enhance reading comprehension. A new instructional approach in which to teach summarization, collaborative summarization, was developed as an alternative to direct instruction to enhance Korean fourth graders' reading comprehension. Collaborative summarization instruction was designed to incorporate scaffolding (Jaramillo, 1996) and active social interaction (Maloch, 2002). Due to the lack of studies where summarization instruction was provided to elementary students (Hidi & Anderson, 1986; Stahl, 2004), fourth graders were selected as participants.

In this chapter, major findings of the study are summarized across the four dependent measures: reading comprehension, identification of main ideas, writing quality, and inclusion of extraneous information. The major findings are interpreted in light of previous search. The limitations of the study in terms of intervention and measures are discussed. Finally, implications for practice are provided and suggestions are made for future research.

Interpretation of Major Findings

The results did not confirm the two research hypotheses of primary interest in this investigation. CS, the new approach that was of primary interest in this investigation, however, positively impacted the fourth graders' summarization skills relative to the control group, while the CS and DI groups did not differ. The DI group did not yield significant results relative to the control group. The benefit of CS instruction was reflected in identification of main ideas and writing quality. Similar to previous research (Armbruster et al., 1987; Nelson & Smith, 1992; Rinehart et al., 1986), the CS group's recall of main ideas was significantly enhanced in comparison to the control students, but no difference was found in memory of details (Armbruster et al., 1987). During instruction, the CS group was prompted to use summarization skills to produce oral and written summaries, so their competencies in identifying important information may have become keen over time.

The CS group's significant improvement was found in writing quality as well. Summarization training contributed to producing well organized summaries (Armbruster et al., 1987). Writing quality scores reflect competencies in organizing and integrating selected important idea units. During the process of producing oral summaries in sessions 1-5, the CS group had opportunities to identify important idea units and organize them in a logical order. When they wrote summaries in the sixth session, the process that they underwent during oral summarization may have been replicated, which was reflected in increased writing quality scores. Writing quality was highly correlated with identification of main ideas ($r = .70, p < .01$). One reason is that the focus and support indices are associated with finding main ideas. The focus index indicates how clearly topics and

main points are addressed and the support index represents how the topics and main points are supported. The students who included more main ideas were likely to earn higher scores in writing quality.

Despite the impact of CS on identification of main ideas and writing quality, the statistical advantage for CS was short-lived. Their summarization gains were washed out on the follow-up test. The maintenance failure may be associated with incomplete mastery of summarization, which is attributable to the fact that the CS group did not have sufficient opportunities to develop summarization in six 20 min sessions. The CS group's competencies in identification of main ideas and writing quality were increasing as a function of intervention, but they did not reach the mastery of summarization. To increase the likelihood that students consolidate newly learned skills, the amount of time spent with instruction should have been extended.

Additionally, the lack of maintenance may be affected by loss of motivation and occurrence of a school event preceding the follow-up test. Depressed scores on the follow-up test were common across the three groups in identification of main ideas and writing quality. The three groups' performance on identification of main ideas was significantly lower than that on the posttest and their performance on writing quality also declined on the follow-up test. According to the common drop in performance on the follow-up test, students may not have been sufficiently motivated to complete the written summarization test with attention. An occurrence of a school event may be another reason for the decline on the follow-up test. The school held track activities for two class periods in which the students participated, followed by the follow-up test. Students'

distractibility or fatigue may have contributed to the declined performance on the summarization test.

Neither of the experimental conditions influenced the students' reading comprehension. The advantages of summarization skills, therefore, were not sufficiently robust to facilitate reading comprehension. The lack of significant differences in reading comprehension between the experimental and control groups does not align with the previous research in which students who received summarization instruction significantly outperformed control students on reading comprehension (Armbruster et al., 1987; Bean & Steenwyk, 1984; Cordero-Ponce, 2000; Gajria & Salvia, 1992; Nelson & Smith, 1992; Rinehart et al., 1986; Wood et al., 1995). Given that the summary intervention was provided to improve fourth graders' reading comprehension, the finding that the experimental groups did not significantly improve in reading comprehension is disappointing and problematic.

Lack of the impact of CS on reading comprehension may be accounted for by the shortage of instructional sessions. CS instruction included silent reading of a passage, instructor's prompts and students' responses, refining students' responses through sharing opinions, and producing an oral summary. In CS, the instructors probed students' current level of knowledge regarding summarization and instructor's assistance was adjusted to their current level of performance (Rodgers, 2004; Wood & Middleton, 1975). The instructors prompted students to identify and apply summarization rules while producing an oral summary. To enhance interaction with instructors and among students, interpretive authority (Chinn et al., 2001), such as giving corrective feedback, was not used. The social-collaborative nature of CS is not familiar to the Korean students given

that their classrooms are arranged for a whole class instruction. Although open participation was introduced in the first session, the students continued to raise their hands for instructor's nomination during CS instruction. Learning through small group discussion is recommended by Korean Ministry of Education (1999) but social, interactive instruction may not occur in reality. Children may need time not only to learn summarization but to adjust to unfamiliar modes of social interaction. In this respect, CS instruction may have required more time so that students got used to the atypical mode of instruction and facile with the summarization skills.

Social cohesion in CS groups may be another reason for the lack of intervention effect. Cooperative learning strongly depends on cohesiveness among group members (Slavin, 1996). The motivation to help and care about one another may occur when group members know one another well. As the CS groups consisted of students from three different classrooms, it may be unreasonable to expect that peer interaction would take place in six 20 min sessions. Without peer interaction, collaborative learning cannot occur. Despite a short term intervention, four 15 min sessions, Kim (2008) showed a significant improvement of Korean students on use of diverse argument stratagems following CR instruction. Social cohesion may be one of the key factors that resulted in the effectiveness of CR session. The CR groups consisted of students from the same classroom and their classroom teachers conducted each session. The CR sessions, thus, may have started on the basis of social relationships that had already been established prior to the time of Kim's study.

In previous research, the instructional procedures followed Rosenshine's (1983) instructional steps or reflected the common features of direct instruction that he clarified.

Rosenshine's instructional steps were also replicated in the current study reflecting the common features of direct instruction. In this regard, summarization instruction that the DI group received was comparable to that of the previous research. A difference, however, was found in terms of the total number of hours spent on intervention. In the current study, a total of six sessions of 20 min were allocated to teaching summarization. Considering that the sixth session was mostly allocated to producing written summaries, teaching of summarization ended in five sessions (100 min). Conversely, more time was allocated to instruction in most of the prior studies. Bean and Steenwyk (1984), for instance, provided a total of 12 sessions of 25-30 min to sixth graders (360 min). In Armbruster et al. (1987), fifth graders received instruction on 11 consecutive days of 45 min (495 min).

In the current study, each direct instruction session was composed of briefly reviewing a summarization rule introduced in the previous session, reading a passage, demonstrating the use of a new summarization rule, guided practice, and independent practice. As four summarization rules were introduced over five sessions, the instructors were restricted in providing various examples, corrective feedback, and time for independent practice. Considering that the participants were fourth graders, the time spent on intervention may have not been sufficient for the students to develop summarization skills.

In previous summarization research, reading comprehension was primarily assessed using researcher-developed multiple choice questions (Gajria & Salvia, 1992; Nelson & Smith, 1992; Wood et al., 1995) or recall (Armbruster et al., 1987; Cordero-Ponce, 2000; Wood et al., 1995). In the current study, the researcher generated sentence

recognition tests following procedures developed by Schmalhofer and Glavanov (1986).

The researcher-developed multiple choice tests primarily focused on memory of main ideas and relevant details, but the sentence recognition tests were used to assess competencies in constructing a meaning of text and integrating the content information of the text with readers' prior knowledge. Such a deep understanding of a text, which was assessed using paraphrase and inference test items (Kintsch, 1994), was not achieved through either experimental intervention.

No intervention effect was found for inclusion of extraneous information in the summaries. Participants in all three groups included fewer extraneous idea units for the posttest and the follow-up test in comparison to the pretest. Armbruster et al. (1987) investigated how the experimental group, who was trained to summarize the problem/solution frame of passages, differed from the control group in terms of inclusion of extraneous idea units in their written summaries. With a passage available for look backs, the experimental and control groups did not show an evident difference but, with a passage unavailable, the experimental group included substantially more extraneous idea units. Armbruster et al. explained that when the experimental students did not understand or remember the passage, they tended to make up extraneous information to fit their summaries of 50 words into the problem/solution frame.

Without looking back at the test passages, the participants in the current study were not limited to the number of words in their written summaries and did not have to fit their summaries into any particular structure. In analysis of the number of sentences in written summaries, all three groups included significantly more sentences in their summaries on the pretest than the posttest and follow-up test. Given the substantial

correlation between the number of extraneous idea units and that of sentences in written summaries on the posttest and follow-up test, reduction in extraneous idea units over time may be accounted for by the fact that students tended to produce shorter summaries on posttest and follow-up test than on the pretest.

Reducing extraneous idea units is necessary to write a summary. Exclusion of extraneous information, however, did not necessarily lead to inclusion of more main ideas. The control group, for instance, was able to reduce extraneous information as well as the experimental groups but their performance in identification of main ideas did not improve.

The subset of students at risk for reading difficulties showed improvement on reading comprehension, identification of main ideas, and writing quality in comparison to their pretest scores on the three measures. The students, however, did not maintain their performance after the intervention ended. Although data from two students does not justify the effectiveness of instruction in summarization for children with or at risk for reading difficulties, the finding shows that this is a potential area for future research.

In summary, CS instruction contributed to identifying main ideas and writing quality summaries. Due to incomplete mastery of summarization skills, however, the CS group failed to maintain their benefits from summarization instruction. Learning summarization skills did not facilitate deep understanding of text. In light of the intervention length in previous research, the experimental students may not have had sufficient opportunities to develop mastery of summarization skills so that they could construct a meaning from text and integrate the content from the text with their prior knowledge. In the same vein, CS may have required more time for students to get facile

with summarization skills, adjust to the new mode of interactive learning, and form socially cohesive relationships. Exclusion of extraneous information is more related to the length of written summaries. Exclusion of extraneous information did not necessarily lead to inclusion of important information.

Limitations of the Study

This study has limitations in incomplete implementation of CS, failure to form social cohesion, and use of a single measure of comprehension. The major limitation is that CS instruction may not have represented its key instructional principles such as open participation, responsive assistance, and peer interaction. Students may not have adjusted to the new mode of instruction and instructors' prompts may not have been responsive to students' level of performance. Students would raise their hands to earn instructors' nomination and interrupt others who were talking by the end of intervention. Instructors' prompts were predominantly questioning, rather than varying according to students' responses on the level of assistance: (a) general encouragement, (b) offering specific verbal information, (c) indicating appropriate piece of information, (d) providing entire information, and (e) demonstrating the whole process of task (Stone, 2002). The following script presents a snapshot of CS instruction. A group of 6 children were discussing a passage, titled *Traditional Clayware*, in session 2 (I = Instructor, C = Child).

I1: Why is an electric boiled-rice warmer addressed with a clayware boiled-rice container in this paragraph?

C1: An electric boiled-rice warmer keeps rice warm but the rice in the electric warmer turns yellowish and smells bad as time goes on. But a clayware boiled-rice container absorbs moisture and keeps the rice fresh.

I2: What differences between the two types do you find?

C2: Boiled rice in a clayware boiled-rice container is fresher than in an electric boiled-rice warmer.

C3: A clayware boiled-rice container can absorb moisture but an electric boiled-rice warmer cannot.

I3: Absorbing moisture seems to be associated with keeping boiled rice fresh. What else is explained about traditional clayware?

C1: Rice cake steamed in an earthenware steamer is properly cooked but that steamed in an aluminum steamer is wet around the inside surface of the steamer.

I4: What commonalities do you see between a clayware boiled-rice container and an earthenware steamer?

(Silence)

I5: In what points are a clayware boiled rice container and an earthenware steamer similar?

C3: Both of them absorb moisture.

C1: Keep boiled rice and rice cake not too wet.

I6: C4, how about an electric warmer and an aluminum steamer?

C4: (Silence), foods are damp.

I7: You are doing pretty good. What else do you find about clayware?

C2: Ancestor's wisdom is also found in a clayware water jar. A clayware water jar cleans water by absorbing harmful materials, removing odor, and sinking impurities.

I8: What is a key idea in those sentences?

The 3 (C1, C2, C3) of 6 students predominantly responded to the instructor and the other three students did not engage in the learning process. Instructors' prompts (I2, I4, I5, and I8) were intended to facilitate students to identify key information and combine relevant information, but the prompts seemed to draw students' attention to finding the

right answers to the instructor's questions. As all interactions took place between the instructor and individual students, peer interaction was unlikely to occur.

Collaborative learning requires social cohesion among group members (Slavin, 1996). Building cohesion may take time, especially among children from different classrooms. Reciprocal Teaching (Palincsar & Brown, 1984), which is rooted in cooperative learning, was performed for 20 sessions of 30 min (600 min). Three groups of 2 students worked in dyads with an adult teacher in 20 sessions. Saleh, Lazonder, and Jong (2007) randomly assigned fourth graders from five classes into heterogeneous learning groups of 4 students. The experimental students worked together for 24 sessions of 35 min (840 min). In both studies, students in dyads or small groups spent much more time together than those in the current study. The CS students, who were from three different classes, were not able to build interpersonal relationship in five 20 min sessions. In Palincsar and Brown's and Saleh et al.'s studies, social cohesion may have been more likely to be established in the dyads and small groups than in groups of 6 to 7 students who spent 100 min together.

Duration is considered to be an important determinant of socially valid research-based programs (Slavin, 2009). Whether or not an educational program is used for an extended time period is an important criterion whereby educators make a decision of the program's effectiveness because external validity is low in studies that are conducted for a short period of time (Slavin, 2009). Slavin set 12 weeks as a criterion for "best evidence" determination.

Another limitation is the use of a single measure of comprehension. SVT was used to develop reading comprehension tests that capture the effectiveness of intervention

by matching what is learned with what is tested (Royer, 2001). SVT tests have been used to assess reading comprehension in several studies, but the effectiveness of intervention on reading comprehension was not found in the test results (Hedin, 2008; McKeown, Beck, & Blake, 2009; Wu, 2009). Using a single measure of comprehension is risky when it fails to capture the effect of interaction.

Implications for Practice

The impact of CS on identification of main ideas and writing quality provides implications for teaching summarization to fourth graders. Throughout CS instruction, students were not given the highest level of assistance. Rather, the instructors started with the least amount of help that would facilitate students' engagement in the learning process. According to Wood and Middleton (1975), students learn better when teacher assistance is adjusted to their level of performance than when the highest level of help, such as demonstration, is provided. As students in this study responded to instructors' prompts at the lower levels, rather than receiving demonstration from the beginning, they were proceeding to a complete oral summary. CS, however, needs to be further refined to build an overarching framework by which any CS instruction should be comparable irrespective of implementers.

Recommendations for Future Research

Implications for future research can be found on the other side of the limitations of this study. As CS instruction was not performed in a way to result in peer interaction, the number of instruction sessions should be extended so that instructor's lead may fade

and, finally, yield to peer control. The Korean students were used to the traditional instruction in the I-R-E format, therefore more time is needed for them to adjust to the new instructional mode. Social cohesion in small groups may not be necessarily fostered over time, so teambuilding activities (Slavin, 1996) may be prepared.

According to the concept of ZPD (Vygotsky, 1978), students are supposed to receive increasingly challenging tasks. In so doing, students can shift their ZPD and become more independent. In this respect, the instructional passages need to be graduated so that instructional passages become increasingly challenging in terms of length and content load of text. Adjustment of the level of assistance is another way to modulate task difficulty.

Reading comprehension is a complex construct to assess using a single measure. Use of multiple measures of reading comprehension is critical to examine different aspects of comprehension and to prevent the occasion when intervention effect is not captured using a single measure of comprehension. McKeown et al. (2009), for instance, used oral recalls with SVTs. The effectiveness of three different approaches was reflected in the oral recall tasks. Wood et al. (1995) used four types of comprehension tests to measure the impact of summarization training: free recall, short-answer questions, multiple-choice questions, and true-false questions. Recall is a comprehension measure that has been most frequently in summarization studies (Armbruster et al., 1987; Cordero-Ponce, 2000; Rinehart et al., 1986; Wood et al., 1995). Confined recall is focused on requiring memory of details as well as main ideas (Armbruster et al., 1987; Rinehart et al., 1986), but free recall is examined for the total number of recalled idea units and main ideas and the arrangement of recalled idea units (Cordero-Ponce, 2000;

Wood et al., 1995). Continued search for valid and reliable measures of comprehension is also needed.

Conclusion

Reading comprehension is an essential goal of reading and prerequisite for academic achievement during schooling. Given that the majority of Korean students who perform below basic reading ability struggle with comprehension, reading comprehension should be the main focus of Korean literacy education. With remarkable increase of informational text at third grade, students encounter many technical words and unfamiliar information and, thus, students struggling with reading are likely to experience overload on understanding informational text. Summarization is found to be effective to facilitate comprehension of informational text, but teaching of summarization skills has been limited to students in middle school or above.

As a consequence of CS instruction, Korean fourth graders improved on identification of main ideas and writing quality, but their learning was not durable. Effectiveness of CS was not found on reading comprehension. Lack of maintenance and significant improvement on reading comprehension may be accounted for by the short term intervention and use of a single measure of comprehension. CS needs to be further refined to build an overarching framework for instructional procedures.

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Appendix A

Grading Criteria for Written Summaries

Students' summary products will be evaluated for two points: inclusion of important information and writing quality.

1. Identification of important idea units

- Divide students' written summaries into idea units, which are independent clauses
- Rate each idea unit for its importance to the passage
 - 1- Least important idea
 - 2- Moderately important idea
 - 3- Most important idea
- When the same main idea appears at multiple times: Only first mentioned main ideas are counted as important information and redundant main ideas will be considered as unimportant information.
- When the same unimportant ideas appear at multiple times: Count the all ideas as unimportant information.

2. Inclusion of extraneous ideas

- Extraneous ideas that are not present in the original passages: Do not give scores but count the total number for comparison across the three intervention groups.

3. Quality of writing

The writing quality of written summaries will be evaluated in terms of the four indexes: focus, support, organization, and integration. Focus score reveals how clearly subjects and main points are addressed. Support score reflects how well and much information in a summary is supported. Organization score indexes use of structure, transitions, and logic in the piece. Integration score reflects the overall development and integration of the features. The four index scores will be combined into one writing quality score by summing them up. The writing quality rubric is attached.

Appendix B
Writing Quality Rubric

Table B1

Three Writing Quality Indices Rubric

Points	Focus	Support	Organization
3	The subject is clear and identified in an opening statement Introduce the topic and show how it will be presented State the overall idea or topic: prepare the reader for how the writer is going to treat the topic Maintain logic throughout Sufficient support to maintain subject The topic is addressed in the thematic direction Have closing (may be restatement of points in the introduction)	Most major points supported with specific details: some may be developed with more detail than others (not balanced or even) Some development of depth Voice is appropriate for topic, purpose, and audience	Evident structure Most major points are appropriately paragraphed Appropriate use of transitions, pronouns, causal linkage, and parallel structure Sentences are cohesively connected
2	Subject is present but is not clearly stated Writer launches into topic without providing an opening statement If previewed, may develop fewer or more points than delineated in opening Minor focus drift or lapse in logic May lack closing Lack sufficiency to demonstrate a developed focus	Most support may be general or underdeveloped Little depth Lack sufficiency to demonstrate developed support Little or no evidence of suitable voice	Structure may be attempted but reader may have to infer it Some structure within paragraphs (e.g., some purposeful ordering of sentences) Some major points are appropriately paragraphed If present, transitions may be simplistic or redundant, but not intrusive May have little evidence of appropriate paragraphing May have little structure within paragraphs Lack sufficiency to demonstrate developed
1	Subject is vague or absent Unrelated ideas or major drift from focus Insufficient writing to meet criteria	Attempt at support is made but confusing, unclear, or redundant Support is absent Insufficient writing to show that criteria are met	No attempt at structure or structure may be attempted with little success (random presentation of ideas) Insufficient writing to meet criteria

Appendix C

Implementation Integrity Checklists

Table C1

Collaborative Summarization Integrity Checklist

Process	Procedures	Yes	No
Peer interaction	Student participation is open Invite students to conversations Reinforce students' engagement Provide no interpretations Stay silent during active conversations		
Responsive assistance	Assistance is contingent on students' responses Use various prompts in each assistance level		

Table C2

Direct Instruction Fidelity Checklist

Process	Procedures	Yes	No
Beginning	Review a summarization rule Provide feedback on student works Present a new summarization rule in small pieces		
Development	Provide demonstration Provide varied examples for difficult tasks Give immediate feedback Have guided practice		
End	Do independent practice		

Appendix D

Levels of Prompts for the Four Summarization Rules

Table D1

Levels of Prompts for Get Rid of Unnecessary Detail

Levels of prompts	Examples
Questioning	What is important in the passage? What is unimportant or trivial information? Is that a big idea? Is that a key idea? Is that essential to understanding the passage?
Directing	Ask students to (a) point to important information (b) underline the important information (c) cross out unimportant information
Demonstrating	As a teacher reads a passage aloud, he or she jots down key ideas in the passage and verbalizes the process through which he or she goes to determine important information
Telling	Say important/unimportant/trivial/redundant information

Table D2

Levels of Prompts for Collapse Lists and Paragraphs

Levels of prompts	Examples
Questioning	Are there words that can be combined into a uniting word? Are there paragraphs that supplement another paragraph?
Directing	Ask students to (a) silently read the passage to see if there are items that can be combined into a superordinate (b) generate a category that covers lists of items, if any (c) seek paragraphs that include supplementary information to support other paragraphs
Demonstrating	A teacher shows the process of seeking items that can be combined under a category and identifying or generating a categorical term to cover the items. A teacher demonstrates finding paragraphs that provide supplementary information to support the other paragraph.
Telling	Indicate a list of items that can be categorized into a term and say a term to cover the items Indicate paragraphs that are used to supplement another paragraph

Table D3

Levels of Prompts for Use Topic Sentences

Levels of prompts	Examples
Questioning	Is there a sentence that incorporates other important ideas? Can the important ideas be combined under a certain topic? Do all the ideas indicate a topic?
Directing	Ask students to (a) identify a sentence that incorporate the content of other sentences in a paragraph (b) generate a sentence that explains other sentences in a paragraph
Demonstrating	Demonstrate the process of identifying a sentence that covers other sentences in a paragraph or generating a sentence that incorporates all the information in other sentences.
Telling	Say topic sentences Say a generated topic sentence when there is no topic Sentence present

Table D4

Levels of Prompts for Polishing the Summary

Levels of prompts	Examples
Questioning	How do you say that in your own words? How do you say that in a different way? Are sentences connected smoothly? How do you make connections between sentences more smooth? Does the introductory statement attract attention? Does the closing statement conclude the summary well?
Directing	Ask students to (a) not copy phrases or sentences from the passage (b) transform the copied phrases or sentences using their own words (c) connect selected important ideas using introductory and closing statements and connecting words
Demonstrating	Change phrases or sentences copied from the passage into Teacher's own words Insert introductory and closing statements Insert connecting words between sentences that are not smoothly connected
Telling	Indicate phrases or sentences copied from the passage and say various expressions Say introductory and closing statements Say connecting words that can be inserted somewhere

Appendix E

Range of Scores on the Four Dependent Measures

Table E1

Range of the Scores on Reading Comprehension, Identification of Main Ideas, Writing Quality, and Inclusion of Extraneous Information

Groups (n)	Test times	Reading comprehension		Main ideas		Extraneous information		Writing quality	
		<i>Min</i>	<i>Max</i>	<i>Min</i>	<i>Max</i>	<i>Min</i>	<i>Max</i>	<i>Min</i>	<i>Max</i>
CS (25)	Pre	30	50	0	50	0	7	3	9
	Post	30	51	0	71	0	3	3	8
	Followup	24	49	0	33	0	7	3	7
DI (26)	Pre	26	52	0	75	0	3	3	8
	Post	30	51	0	86	0	3	4	9
	Followup	25	50	0	60	0	3	3	8
Control (24)	Pre	33	47	0	75	0	8	3	9
	Post	24	48	0	71	0	5	3	8
	Followup	24	49	0	33	0	8	0	7

Appendix F
Examination of Group Equivalence

Table F1

Analysis of Variance for Group Equivalence

Assessment	Source	SS	df	MS	F	<i>p</i>
DTBS	Between subjects	13.33	2	6.66	.66	.520
	Within subjects	727.42	72	10.10		
RC	Between subjects	3.44	2	1.72	.06	.942
	Within subjects	2073.84	72	28.80		
MI	Between subjects	150.02	2	75.01	.21	.811
	Within subjects	25774.98	72	357.99		
EI	Between subjects	7.88	2	3.94	1.13	.329
	Within subjects	250.84	72	3.48		
WQ	Between subjects	.99	2	.50	.19	.824
	Within subjects	184.68	72	2.57		

Note. DTBS = Diagnostic tests of basic skills of elementary students, RC = Reading comprehension, MI = Identification of main ideas, EI = Inclusion of extraneous information, WQ = Writing quality.

Appendix G

Repeated Measures Analysis of Time-by-Condition Interaction

Table G1

Repeated Measures Analysis for Time-by-Condition Interaction Effect Between Two Test Times

Test times	Source	Type III SS	df	MS	F	p
CS-control						
Pre-post	Time×condition	12.99	1	12.99	.73	.396
	Error	833.40	47	17.73		
Post-followup	Time×condition	101.67	1	101.67	8.21	.006***
	Error	582.31	47	12.39		
Pre-followup	Time×condition	187.34	1	187.34	13.87	.001***
	Error	634.76	47	13.51		
DI-control						
Pre-post	Time×condition	15.39	1	15.39	.96	.331
	Error	767.61	48	15.99		
Post-followup	Time×condition	150.65	1	150.65	12.28	.001***
	Error	588.79	48	12.27		
Pre-followup	Time×condition	262.34	1	262.34	18.37	.000***
	Error	685.50	48	14.28		

Note. ** $p < .01$, *** $p < .001$

Table G2

Repeated Measures Analysis for Time-by-Condition Interaction Effect on Writing Quality Involving Two Test Times Between Two Groups

Test times	Source	Type III SS	df	MS	F	p
CS-DI						
Pre-post	Time×condition	1.91	1	1.91	1.59	.214
	Error	50.05	49	1.21		
Post-followup	Time×condition	8.83	1	8.83	7.98	.007**
	Error	54.17	49	1.11		
Pre-followup	Time×condition	2.52	1	2.52	2.36	.131
	Error	52.44	49	1.07		
CS-control						
Pre-post	Time×condition	8.79	1	8.79	6.48	.014*
	Error	63.76	47	1.36		
Post-followup	Time×condition	.58	1	.58	.35	.558
	Error	78.48	47	1.67		
Pre-followup	Time×condition	4.85	1	4.85	3.20	.080
	Error	71.13	47	1.51		
DI-control						
Pre-post	Time×condition	2.64	1	2.64	1.81	.185
	Error	70.25	48	1.46		
Post-followup	Time×condition	4.71	1	4.71	2.67	.109
	Error	84.65	48	1.76		
Pre-followup	Time×condition	14.40	1	14.40	10.20	.002**
	Error	67.81	48	1.41		

Note. * $p < .05$, ** $p < .01$

Appendix H

Pairwise Comparisons by Condition

Table H1

Pairwise Comparisons of Extraneous Information by Condition Using Tukey HSD

Groups	Mean difference	Standard error	<i>p</i>
CS-DI	.54	.273	.129
CS-control	-.15	.279	.851
DI-control	-.69	.276	.039*

Note. * $p < .05$

Appendix I

Korean Instructional Passages for the Pilot and Study

Instructional passages for the pilot

Session 1.

하품도 전염되는가?

하품도 전염이 될까? 하품은 병처럼 걸릴 수 있는 것은 아니지만 다른 사람이 하품하는 것을 보면 우리도 하품하고 싶어진다. 네가 하품하고 싶은 느낌이 들 때 주변의 친구에게 네 얼굴을 쳐다보라고 해보렴. 네가 여러 차례 하품을 하는 것을 보면 아마 네 친구도 하품하기 시작할거야.

엘리자베쓰라는 과학자가 아프리카에서 사자를 연구할 때 있었던 일이란다. 엘리자베쓰는 사자들을 자세히 관찰하기 위해 사자들이 그녀의 얼굴을 볼 수 있을 만큼 가까이 다가갔단다. 사자들을 관찰하던 중 하품을 하게 되었는데 사자들 중 한 마리가 그녀를 쳐다보며 하품하는 모습을 보고는 깜짝 놀랐단다. 그렇다면 애완용 개나 고양이가 하품하게 만들 수 있을까? 한 번 해보렴.

Session 2.

피부와 뼈

동물의 가죽과 뼈를 이용하여 만들 수 있는 음식은 무엇일까? 바로 젤라틴이다.

젤라틴을 만드는 과정을 살펴보자. 우선, 가죽과 뼈를 씻는다. 깨끗이 씻긴 가죽과 뼈를 산성 용액이 들어있는 커다란 통에 넣는다. 통에 담긴 가죽과 뼈를 몇 시간 동안 매우 빠른 속도로 저어주면 가죽에 용액이 스며들어 부풀어 오른다.

부풀 가죽과 뼈에 몇 시간 동안 열을 가하면 가죽과 뼈에서 젤라틴이라는 물질이 빠져 나온다. 이 젤라틴을 여과하여 건조시킨 후 다시 냉각한다. 냉각된 젤라틴은 얇게 잘려 건조대로 옮겨진다. 충분히 건조된 젤라틴은 곱게 갈려 포장지에 담겨진다.

집에서 젤라틴 디저트를 만들 경우, 젤라틴 가루에 설탕, 과일 향, 기타 첨가물을 섞고 뜨거운 물을 부어 저어주면 젤라틴 가루와 첨가물들이 녹는다. 물에 녹은 젤라틴을 냉장고 속에 넣어두면 서서히 굳는다. 손가락으로 건드려 보았을 때 표면이 가볍게 흔들리면 다 굳은 것이다.

Session 3.

살아있는 공룡

약 100년 전, 뱀사람들은 사람을 공격하는 거대한 도마뱀이 우글거리는 섬에 대한 얘기들을 했다. 진짜 그런 섬이 있었던 것일까? 섬에 살고 있던 것은 도마뱀이 아니라 공룡이 아니었을까?

뱀사람들의 얘기는 모두 사실이였다. 하지만 사람을 공격하는 거대한 동물은 공룡이 아니라 코모도 왕도마뱀이었다. 코모도 왕도마뱀은 세상에서 가장 큰 도마뱀이다. 이것이 다 자라면 몸 길이가 3미터, 몸무게는 136킬로그램 정도된다.

코모도 왕도마뱀은 위험하며 자신보다 훨씬 큰 동물도 죽일 수 있다. 발톱은 먼도날처럼 예리하고 이빨은 톱날 같다. 입 속에는 치명적인 세균들이 살고 있어서 한 번 물리면 죽을 수도 있다. 이 도마뱀은 지독한 냄새를 풍기며 성질도 사납다. 코모도 왕도마뱀은 잘 달리고, 수영도 할 수 있으며, 심지어 나무에도 오를 수 있다. 그래서, 코모도 왕도마뱀과 마주쳤을 때 이들을 피해 달아나기란 쉽지 않다.

Session 4.

수영을 오래 하면 왜 손이 쭈글쭈글해질까?

사람의 피부는 단백질로 이루어져 있으며 피부 안쪽에 있는 세포에서 만들어진다. 단백질은 물에 젖으면 부풀어 오르기 때문에 수영을 오래 하면 피부가 쭈글쭈글해진다. 그런데 물에 젖은 피부가 고르게 부풀어 올라 평평해지지 않고 오히려 쭈글쭈글해지는 것은 피부의 바깥쪽과 안쪽이 팽창하는 정도가 다르기 때문이다. 피부의 안쪽은 근처에 있는 세포들과 결합되어 있기 때문에 바깥 쪽만큼 많이 부풀어 오르진 않는다. 밖에서는 부풀어 오르지만 안쪽에서는 팽조여주는 힘이 작용하기 때문에 주름이 생긴다. 피부가 쭈글쭈글해진다고 걱정할 건 없다. 피부에 스며들었던 물기가 마르면 피부는 다시 매끈해진다.

그런데 왜 손바닥과 발바닥 피부만 그렇게 쭈글쭈글해지고 다른 곳의 피부에서는 큰 변화가 없는 것일까? 손바닥과 발바닥 피부는 다른 곳에 있는 피부보다 두껍다. 피부가 두꺼운 곳에서는 그만큼 많은 양의 단백질이 들어있다. 손등보다 손바닥에 더 많은 주름이 생기는 이유는 여기에 있다.

Session 5.

뇌를 이해하기

소뇌는 대뇌 아래쪽에 붙어 있다. 소뇌는 근육의 활동을 조정하며 몸의 균형을 잡아주는 역할을 한다. 올림픽 체조 선수의 소뇌가 사고로 손상을 입으면 어떤 일이 생길까?

크기는 작지만 중요한 역할을 하는 또 다른 부위는 뇌간이다. 뇌간은 대뇌를 떠받쳐주며 뇌와 척수를 연결해 준다. 뇌간은 호흡을 조절하고 생명을 유지하는데 필수적인 여러 작용들을 통제한다.

18 살이 될 때까지 뇌는 빠른 속도로 자란다. 하지만 뇌의 성장이 멈춘 이후에도 시냅스는 계속해서 만들어질 수 있다. 어떠한 경험을 하는 지가 시냅스 형성에 중요한 역할을 한다. 뇌가 끊임없이 활동함으로써 새로운 시냅스를 형성해 갈수록 뇌는 더욱 건강해진다. 뇌는 쓰면 쓸수록 더욱 강해진다.

Session 6.

거미

거미는 몸집이 작고, 여덟 개의 다리를 갖고 있으며, 몸에서 실을 자아낸다. 거미가 자아낸 실은 가장 강력한 천연 섬유들 중 하나이다. 많은 사람들이 거미가 개미, 벌, 풍뎅이와 같은 곤충류라고 생각하지만 거미류에 속한다. 거미는 곤충과 달리 날개와 더듬이가 없으며, 곤충보다 다리가 두 개 더 많다.

많은 거미들은 실로 거미집을 만들어 곤충을 잡는다. 어떤 거미들은 은신처에 숨어있다가 갑자기 곤충들을 공격해서 잡는다. 대부분의 거미들은 독이 있는 날카로운 이빨(독니)이 있다. 독니는 먹이로 잡은 곤충이나 동물을 죽이는데 사용된다.

단지 몇 종류의 거미들만이 사람들에게 해롭다. 대부분의 거미들은 농작물에 피해를 주는 메뚜기, 병을 옮기는 파리나 모기 같은 해로운 곤충들을 죽여주기 때문에 사람에게 유익하다.

핀의 머리만큼 아주 작은 거미도 있지만 사람 손 만한 거미도 있다. 거미는 먹이가 있는 곳이라면 어디에서나 살 수 있다. 많은 거미들이 집이나 헛간, 기타 여러 건물들에서 산다. 어떤 거미들은 정원, 숲, 동굴, 심지어 사막에서 산다.

현재까지 약 3 만 종의 거미가 있는 것으로 밝혀졌지만 아직 연구되지 않은 거미들이 더 있을 것이다.

Instructional passages for the study

Session 1.

경칩

경칩은 24 절기의 하나로, 대개 3월 초가 됩니다. 경칩이라는 말은 땅 속에서 몸을 움츠리고 겨우내 잠을 자던 동물들이 깨어 꿈틀거리기 시작한다는 뜻입니다. 경칩은 봄이 시작되는 때와 비슷한 시기에 있기 때문에 새로운 출발의 뜻이 있기도 합니다.

우리 조상들은 경칩에 여러 가지 일을 하였습니다. 경칩에 흙을 이용하는 일을 하면 일 년 내내 나쁜 일이 생기지 않는다고 생각하여 벽이나 담에 흙을 바르거나 집을 새로 지었습니다. 또, 빈대를 없앨 수 있다고 생각하여 물에 재를 탄 그릇을 방의 네 귀퉁이에 놓기도 하였습니다. 보리싹이 자란 것을 보고 그 해 농사가 풍작일지 흉작일지를 점치기도 하였습니다. 그러나 오늘날에는 이러한 풍습이 많이 사라지고 있습니다.

경칩 무렵, 겨울잠에서 깨어난 개구리가 기지개를 켜고 밖으로 나옵니다. 막 잠을 깬 개구리는 아직 차가운 냇물이나 웅덩이, 또는 물이 껴어 있는 논 등에다 알을 낳습니다. 새로운 생명이 태어나게 할 준비를 서두르는 것입니다. 이것을 보고 우리는 새 봄이 왔음을 알 수 있습니다.

Session 2.

우리의 질그릇

우리는 여러 용도의 질그릇에서 선조들의 해박한 과학 지식과 위생 관념을 확인할 수 있다.

우선, 질그릇 밥통부터 살펴보자. 현대 문명의 산물인 전기 밥통은 보온은 되나, 시간이 지나면 밥이 누렇게 변색되고 냄새도 난다. 그러나 질그릇 밥통은 통 속에 서려 있는 김을 그릇 자체가 흡수하여 신선한 밥맛을 보존하는 위생적인 그릇이다.

시루도 마찬가지이다. 알루미늄 시루는 그 벽에 김이 서려, 벽면에 붙은 떡은 물기가 많은 것을 볼 수 있다. 그러나 질그릇 시루에 찐 떡은 고슬고슬하여 떡의 고유한 맛이 살아 있다.

또, 옛날에 우리 가정의 필수품으로 쓰였던 질그릇의 하나로 질화로가 있다. 우리 민족의 소박한 정서가 깃들여 있는 이 질화로는 지금은 사라져 그 모습을 찾아보기 힘들지만, 겨울에 방안의 실내 공기를 따뜻하게 해 주는 중요한 구실을 하였다. 그것은 열전도가 잘 되지 않는 질그릇의 특성을 이용한 것이다.

물독에서도 우리 선조들의 지혜로운 일면을 확인할 수 있다. 물독은 물 속에 섞여 있는 해로운 물질을 흡수하여 악취를 제거하고, 불순물을 가라앉혀 식수 위생에 기여하였다.

이처럼 우리 선조들이 만들어 널리 사용한 질그릇은, 오랜 세월을 통하여 얻어진 경험에서 나온 생활 과학의 산물이다.

Session 3.

윷놀이

윷놀이는 우리 나라 고유의 민속 놀이이다. 좁은 장소에서 남녀노소 누구나 함께 즐길 수 있는 대표적인 놀이의 하나이다. 윷놀이는 중국의 ‘저포’라는 놀이에서 전래되었다는 이야기도 있지만, 우리 나라에서는 이미 삼국 시대 이전부터 널리 행해져 왔다. 부여의 왕이 다섯 종류의 가축을 다섯 마을에 나누어 주고, 그 가축들을 잘 번식시키기 위하여 윷놀이를 하였다고 한다. 그래서 윷놀이를 할 때에 ‘도, 개, 걸, 윷, 모’를 ‘돼지, 개, 양, 소, 말’에 비유하기도 한다.

윷놀이는 보통 두 편으로 갈라 각 편이 윷가락을 번갈아 던져서 승부를 겨루는 놀이이다. 윷놀이를 하기 위해서는 윷가락, 윷판, 그리고 보통 네 개의 말을 준비해야 한다. 윷가락을 던져서 네 개가 다 떨어지면 ‘모’, 네 개가 다 잡혀지면 ‘윷’, 세 개가 잡혀지면 ‘걸’, 두 개가 잡혀지면 ‘개’, 한 개가 잡혀지면 ‘도’라 한다. 윷판에 말을 놓을 때에는 도는 한 발, 개는 두 발, 걸은 세 발, 윷은 네 발, 모는 다섯 발을 움직인다. 앞서 가는 상대방의 말을 잡을 수도 있다. 상대방 말을 잡거나, 윷 또는 모가 나오면 다시 한 번 던질 수 있는 기회가 주어진다. 이렇게 하여 말 네 개가 모두 상대방보다 먼저 윷판의 마지막 자리인 참먹이로 돌아오면 이기게 된다.

웃놀이는 원래 정월 무렵에, 농민들이 그 해 농사가 높은 지대에서 잘 될까, 낮은 지대에서 잘 될까를 점치던 옛날 풍습의 하나였다. 그러나 오늘날에는 계절에 관계 없이 남녀노소 누구나 즐기는 놀이가 되었다.

Session 4.

씨름

씨름은 먼 옛날부터 행해져 온 우리 겨레의 고유한 민속 놀이이다. 고구려의 옛 무덤에는 씨름하는 모습의 벽화가 그려져 있다. 이것으로 보아, 씨름은 고구려 때나 그 이전부터 시작되었을 것으로 짐작된다. 고구려에서 부족 간 경기 종목의 하나로 성행하였던 씨름은 고려를 거쳐 조선 시대로 이어져 발전하였다. 세종 대왕도 군사들의 씨름 경기를 보며 즐겼다고 한다. 이처럼 씨름은 오랫동안 우리의 민속놀이로 전해 내려왔다.

씨름에는 왼씨름, 오른씨름, 띠씨름이 있었다. 왼씨름은 오른쪽다리에 건 살바를 잡고 오른쪽 어깨를 마주 대고 하는 것이고, 오른씨름은 왼쪽 다리에 건 살바를 잡고 왼쪽 어깨를 마주 대고 하는 것이다. 띠씨름은 허리에다 띠를 매고 그것을 잡고 하는 씨름이다. 그러나 지금은 왼씨름 하나로 통일되었으며, 이름도 바른씨름으로 바뀌었다.

씨름은 두 사람이 상대방의 살바를 붙잡고 승부를 겨루는 경기로서, 먼저 넘어지거나 손이나 무릎이 땅에 먼저 닿는 쪽이 지게 된다. 씨름은 살바를 붙잡고 겨루는 경기이기 때문에 배지기, 뒤집기, 다리걸기 등 여러 가지 기술이 많이 발달하게 되었다.

씨름은 주로 단오와 추석에 즐겨 하였지만 농한기에도 성행하였다. 씨름판에서 맨 마지막으로 이기는 것을 ‘판막음’ 또는 ‘판막이’라고 한다. 판막음을 한 사람에게는 흔히 황소 한 마리를 상으로 주었다.

우리는 우리 겨레의 얼과 기상이 담겨 있는 씨름을 더욱 아끼고 사랑하여, 세계적인 운동 경기로 발전시켜 나가야 할 것이다.

Session 5.

성장통

상민이는 저녁만 되면 다리가 아파서 걱정을 하였다. ‘지난번에 축구를 하다가 명수와 부딪혔는데, 그 일 때문에 다리가 잘못된 것은 아닐까?’ ‘혹시 소아마비가 아닐까?’ 상민이는 걱정이 되어 어머니와 함께 병원에 가서 엑스선 사진을 찍어 보았다. 의사 선생님께서는 ‘성장통’이라고 진단을 내리신 후에야 상민이는 안심을 하였다. 의사 선생님께서는 이런 어린이들이 많다고 말씀하셨다.

주로 초등 학교 학생에게 나타나는 성장통은 종아리와 정강이 또는 허벅지가 아픈 증상을 보인다. 대개 저녁때에 아파 오는데, 푹 쉬거나 자고 일어나면 통증이 씻은 듯이 없어진다. 소아마비와 비슷한 증상을 보이나, 소아마비 예방 접종을 받은 어린이라면 크게 걱정할 것이 없다.

성장통의 원인은 정확하게 밝혀지지 않았지만, 키가 자라면서 뼈를 싸고 있는 막이 늘어나 뼈 주위의 신경을 건드리기 때문이라고 한다. 따라서 성장통은 성장 속도가 빠르고 활동적인 어린이에게 흔히 나타난다.

이러한 성장통을 예방하려면 관절에 무리를 주는 심한 운동을 피하여야 한다. 그리고 우유, 콩, 멸치 등 단백질과 칼슘을 보충할 수 있는 음식을 골고루 먹는 것이 좋다.

지구는 지금으로부터 약 46 억 년 전에 생겼다고 한다. 그 무렵의 지구는 아주 뜨겁고 흐물흐물한 상태로 수증기와 염소, 나트륨 성분이 섞인 가스를 뿜어 내고 있었다. 염소와 나트륨이 만나서 염화나트륨, 곧 소금이 되었고, 수증기는 모여서 구름이 되었다. 지구가 차츰 식으면서 구름은 비가 되어 땅 위로 쏟아져 바다를 이루었다. 이 때 소금도 함께 바닷물에 녹게 되었다.

소금은 지구 곳곳에서 여러 가지 방법으로 얻어진다. 오늘날 세계 소금 생산량의 약 3분의 2 가 암염덩이에서 얻어 낸 돌소금이다. 돌소금이 전혀 나오지 않는 우리 나라에서는 염전에 바닷물을 끌어들여서 태양열로 수분을 증발시키는 천일 제염법으로 소금을 얻기도 하고, 바닷물에 녹아 있는 소금을 전기의 힘으로 분리하여 얻기도 한다. 오늘날에는 염전이 아닌 공장에서도 소금을 만들 수 있게 되었다.

인류의 역사를 돌이켜보면, 언제, 어느 곳에서나 소금은 중요한 구실을 해 왔다. 사냥감을 찾아 떠돌아다니던 먼 옛날 사람들은 짐승과 물고기, 조개 따위를 먹고 살았기 때문에, 그 속에 든 소금기를 자연히 섭취할 수 있었다. 그러나 한 곳에 정착하여 농사를 짓게 되자, 식물성 식품을 주로 먹게 되어 소금이 많이 필요하게 되었다. 그래서 소금 만드는 일만 하는 사람이 생기고, 소금이 귀해져서 돈의 구실까지 한 때도 있었다.

고대 로마에서는 병사들의 봉급으로 소금을 주기도 하였고, 중국에서는 세금으로 소금을 징수한 때도 있었다. 옛날에는 우리 나라에서도 소금을 만들고 파는 일을 나라에서 관리하였다고 한다.

사람들은 소금을 음식 맛을 내거나 염장 식품을 만드는 데 사용한다. 염장 식품은 수분을 빨아들여서 세균이 생기는 것을 막아 주는 소금의 성질을 이용한 식품이다. 간장, 된장, 고추장, 자반, 젓갈 등이 염장 식품의 예이다. 또, 소금은 공업용으로도 쓰인다. 나일론, 비누, 종이, 약품, 표백제, 살충제 등의 원료로 소금이 사용된다.

그 밖에도 소금은 일상 생활에서 유용하게 쓰인다. 감기를 예방하기 위하여 소금 양치질을 하기도 하고, 꽃꽂이할 꽃을 싱싱하게 유지하기 위하여 가지를 잘라 소금물에 담그기도 한다. 또 껍질을 벗긴 사과를 소금물에 담갔다가 건져 내어 변색되는 것을 막기도 하고, 달걀을 삶을 때에 소금을 조금 넣어서 껍데기가 갈라지는 것을 막기도 한다.

Appendix J

English Instructional Passages for the Pilot and Study

Instructional passages for the pilot

Session 1.

Is yawning contagious?

Do you think yawning is contagious? Even though yawning is not a disease you can catch, seeing another person yawn may make you want to yawn too. The next time you feel a yawn coming on, ask a friend to watch your face. If you yawn several times, your friend will probably start to yawn too.

When a scientist named Elizabeth Thomas was studying lions in Africa, she was close enough for some of them to see her face. She was surprised to see that when she yawned, one of the lions yawned too. Do you think you could make a pet dog or cat yawn? Try it!

Session 2.

Skin and bones

What food is made from the skins and bones of animals? Gelatin!

The skins and bones are cleaned. Then both are put in a tank of acid. The skins and bones (called stock) are stirred very fast for several hours. This process “plumps” the skins.

After plumping, the stock is heated several times. Gelatin is removed after each heating. The gelatin is filtered, dried, cooled, and spread in layers to set. The layers of gelatin are next cut into a power and packaged.

When your mother makes gelatin dessert that tastes like lemon, raspberry, grape, or orange, she uses gelatin that has been mixed with sugar, fruit flavoring, and other things. She pours hot water into the powder and stirs it. Then she puts it into the refrigerator to harden – not as hard as bone – just solid enough so that it wiggles and shakes when you poke your spoon into it.

Session 3.

Living dragons

About 100 years ago, sailors told stories about islands filled with giant lizards that attacked people. Were the stories true? Could the lizards be dinosaurs?

The stories were true, but the strange animals were not dinosaurs. They were Komodo (kuh MOH doh) dragons. Komodos are the largest lizards in the world at 10 feet long and 300 pounds.

Komodo dragons are dangerous and can kill animals much bigger than they are. Their claws are razor sharp and their teeth are like saws. Their mouths have deadly germs, so even one bite can kill you. And they smell terrible! It’s not easy to escape these fierce lizards – they run, swim, and climb trees!

Session 4.

Why does the skin on my hands wrinkle when I swim too long?

The tough outer layer of skin is protein, made by the living cells underneath. Just like other proteins, it swells up when it is soaked in water. But it is not free to expand evenly in all directions because it is attached to the layer underneath. As it swells outward in some places, it is forced to pinch inward in other places. That makes wrinkles. But do not worry. Your skin will smooth out again as it dries.

You may wonder why this doesn’t happen to other parts of your body. That outside layer of skin is thicker on the palms of your hands and the bottoms of your feet than it is on most other

body parts. So there is more protein swelling up all in one place. That's why the skin on your palm wrinkles more than the skin on the back of your hand.

Session 5.

Understanding the brain

Cerebellum. The cerebellum lies below the cerebrum. This part of your brain coordinates muscle activity and helps you keep your balance. What do you think might happen to an Olympic gymnast if her cerebellum were damaged in an accident?

Brain stem. Another small but important part of the brain is called the brain stem. The brain stem lies at the base of the cerebrum and connects and the brain to the spinal cord. The brain stem controls breathing and other involuntary functions that keep us alive.

Your brain grows quickly until you're about 18 years old. However, even when a brain stops growing in size, it doesn't stop making connections. In fact, your brain can continue to develop in complexity based on your experiences. Many studies have shown that our brains stay healthiest when they are constantly active. When it comes to brainpower, the phrase "use it or lose it" certainly applies.

Session 6.

Spider-iffic

A spider is a small, eight-legged animal that spins silk. The spider's silk is one of the strongest natural fibers. Many people think spiders are insects like ants, bees, and beetles, but they are in a group called arachnids. Unlike insects, which have six legs, spiders do not have wings and antennae, or feelers.

Many spiders, but not all, spin their silk threads into webs that are used to catch insect for food. Other spiders catch insects with a surprise attack from a hiding place. Most spiders have fangs with poison. The fangs are used to kill insects and animals for food.

Only a few kinds of spiders are harmful to people. Instead, most spiders are helpful because they kill harmful insects, such as the ones that can destroy a farmer's crop (locusts and grasshoppers) and the ones that carry diseases (flies and mosquitoes).

Spiders can be smaller than a pinhead or as big as a person's hand. They can live just about anywhere, as long as there is food around. Many spiders live in houses, barns, and other buildings. Others live outside in gardens, the woods, caves, and even the dessert.

There are about 30,000 types of spiders that we know about, but there could be many more that have not yet been studied.

Instructional passages for the study

Session 1.

The end of hibernation

The end of hibernation is one of the 24 subdivisions of seasons and begins on March. Around the end of hibernation, animals that have hibernated during winter wake up and are active. The end of hibernation corresponds to the start of spring, so it connotes a new beginning.

Ancestors did several activities on the end of hibernation. They believed that they can prevent something bad from happening by using soil during an entire year. Therefore, ancestors resurfaced walls or built houses using soil. Ancestors also put a bowl of water with ashes in the corners of each room and they believed that the bowl of water will repel bedbugs. Observing how barley buds grow, ancestors foretold whether or not the crops would be abundant. However, many of these customs do not continue any more these days. On the end of hibernation, frogs wake up. The frogs lay eggs in the cold water of streams and puddles or a rice field filled with water. Seeing the frogs prepare for a new life cycle, we notice that spring comes.

Session 2.

Traditional clayware

We can see our ancestors' wide scientific knowledge and sense of hygiene that are embedded in various types of clayware.

Let us start with clayware boiled rice containers. Electric rice cookers keep boiled rice warm, but the rice turns yellowish and smells bad over time. Clayware rice containers, however, absorb moisture in the container and keep the boiled rice fresh.

Earthenware steamers are similar to the clayware boiled rice container. Aluminum steamers do not absorb moisture and vapor stays on the surface of aluminum steamers. Thus, rice cake that is cooked in aluminum steamers is moist around the surface of steamers. However, earthenware steamers properly cook rice cake and keep the taste fresh.

Additionally, clayware warmers are one of the necessities used in the household. Clayware warmers are no longer used now, but they had been useful for keeping rooms warm. Clayware warmers reflect the feature that heat is not transferred well through clayware.

Our ancestors' wisdom is also found in water jars. Water jars absorb impurities in water and removes odor. In so doing, water jars contributed to the sanitation of drinking water.

As mentioned above, clayware had been widely used by our ancestors and it is a scientific product that had been gained through years of life experience.

Session 3.

A game of Yut

Yut is a Korean traditional folk game. People at all ages enjoy the game even in a small place. It is said that Yut originated from Jeopo, a Chinese game, but it had been widely played before the period of Three States. In fact, the game began as a king of Buyeo distributed five domestic animals to five villages and encouraged the villagers to breed them well. 'Do, Gae, Geol, Yut, and Mo' symbolize five animals: pig, dog, sheep, cattle, and horse.

People are split into two teams and each team throws four Yut sticks in turns. Yut sticks, a board, and four markers are needed to play Yut. When four sticks fall on their faces, it is counted as 'Mo'. When four sticks lie with faces up, it is 'Yut'. 'Geol' is when three sticks lie with faces up. 'Gae' is when two sticks lie with faces up and 'Do' is when only one stick faces up. Markers are placed according to the number of sticks that face up or fall down on their faces. The other team's markers can be caught. The team who catches the other team's markers or who throws Yut

and Mo can throw sticks once more. The game ends when a team's four markers arrive at the home base.

Playing the Yut, people also foretold whether farming would go well on lower or higher places. It has become the most popular game nowadays.

Session 4.

Korean wrestling

Korean wrestling is a unique folk game that has been carried on since a long time ago. A scene of Korean wrestling is depicted in a tomb mural of Koguryo. According to the tomb mural, Korean wrestling is assumed to start in or before the period of Koguryo. Korean wrestling, as a prevalent sporting event, continued to be played until the Koryo and Chosun dynasties. King Sejong enjoyed watching soldiers wrestling. Korean wrestling has been transmitted as our folk game.

There were three types of wrestling: left-hand, right-hand, and belt-hold wrestling. Left-hand wrestling is when two wrestlers hold each other's thigh band in the right leg and face their right shoulders. Right-hand wrestling is when two wrestlers hold each other's thigh band in the left leg and face their left shoulders. Belt-hold wrestling is performed as two players hold each other's belt that is tied around waist. The three types of wrestling have been combined into left-hand wrestling and renamed to 'right wrestling'.

Two wrestlers hold each other's thigh band and the person who falls first or whose hands or knees touch the ground loses the game. Waist tackle, overturning, and leg lock are some of the wrestling skills.

Korean wrestling was mostly enjoyed on the Dano festival and moon festival, but it was also performed on days in the agricultural off-season. The final winner was called 'panmakeum' or 'panmaki' and was awarded a bull.

We should value the Korean wrestling since our ancestors' spirit and nature are embedded in the wrestling and we also need to develop the Korean wrestling into a global sporting event.

Session 5.

Growth pain

Sangmin was worried that his legs were sore every night. 'I bumped into Myungsoo while playing soccer last time and is there anything wrong with my legs as a result of the crash?' 'Do I have polio? Sangmin went to a hospital with his mom and got a X-ray taken. As the doctor diagnosed him with 'growth pain', he was relieved. The doctor said that many children would experience growth pain.

Growth pain is common for elementary children and it occurs in calf, shank, and thigh. The pain usually begins at night, but it completely disappears after rest or sleep. The symptom of growth pain is similar to that of polio, but the children who received polio vaccination do not have to worry.

The cause of growth pain has not been completely understood yet. When children grow, membranes surrounding bones stretch out and touch nerves around the bones. Growth pain is common to children who grow fast and are active.

To prevent growth pain, children need to avoid exercise that burden joints. Additionally, children have to eat milk, beans, and anchovy, which complement protein and calcium.

Salt

Earth was created about 46 billion years ago. The Earth, very hot and flabby, was sending out gas, which was a mixture of vapor, chlorine, and sodium. Chlorine and sodium were mixed and became sodium chloride, salt. The vapor gathered and turned into clouds. As the Earth slowly cooled off, clouds turned into rain and the rain dropped on land. The rain on land gathered into an ocean. The ocean water caused salt to melt, so the ocean water became salty.

Salt is obtained in several ways from many corners of the Earth. Today, approximately two thirds of world production of salt is obtained from rock salt. Rock salt is not found in Korea, so salt is made by evaporating the ocean water dragged into salt fields using sunlight. Or, salt dissolved in the ocean water is separated using electric power. Salt can be produced in a plant as well as salt fields.

Throughout human history, salt has been treated as an important material anywhere. People who wandered around to hunt a long time ago could ingest salt eating animals, fish, and shellfish. As people settled down in a place for farming, they mostly ate vegetable foods and, thus, they needed more salt. In this situation, somebody became in charge of producing salt and salt became valuable and used as money.

Salt was used to pay soldiers in the Roman Empire. In China, people paid salt for taxes. In old days of our country, the government managed production and sale of salt. Salt has been used to season foods and create salted foods. Salt absorbs moisture from foods and prevents bacteria. Soy sauce, soybean paste, hot pepper paste, and salted fish are examples of salted foods. Salt is also used for an industrial purpose. Salt is needed to manufacture nylon, soap, paper, drugs, bleach, and insecticide.

In addition, salt is useful for everyday life. Gargling with salt helps to prevent colds. Cut flowers remain fresh in salt water. One can prevent decoloration of peeled apples by dipping them into salt water for a while. Additionally, eggs will not crack in boiling water when you add a little salt into the boiling water.

Appendix K

Korean Test Materials for Reading Comprehension and Written Summarization

Pretest Materials

이 검사는 글을 읽고 그 내용을 얼마나 잘 이해하고 있는 지를 평가하기 위한 것입니다. 여러분은 한 번에 하나씩 모두 4 개의 글을 읽게 될 것입니다. 각각의 글을 주의 깊게 읽고 주어진 문제에 답해 보세요.

동물들은 땀을 흘릴까?

개는 땀샘을 갖고 있지만 땀을 흘리지 않는다. 개는 체온을 낮추기 위해 입을 벌리고 혀를 내밀어 빠르게 숨을 쉰다. 숨을 헐떡일 때 입에서 수분이 증발하면서 열도 함께 빠져나간다. 코끼리는 땀샘을 갖고 있지 않다. 큰 귀로 부채질 하거나 긴 코로 몸에 물을 끼얹어서 불필요한 열을 없앤다. 하마는 피부에 있는 분비샘에서 기름기 있는 분홍색 액체를 내보낸다. 이 액체는 하마의 피부가 마르지 않게 해준다.

사람들은 왜 운동 후에 샤워를 할까? 땀을 씻어내고 싶어서 이기도 하지만 또 다른 이유가 있다. 처음 땀이 나기 시작할 때는 냄새가 나지 않는다. 그렇지만 박테리아가 땀을 분해하기 시작하면서 고약한 냄새가 발생한다. 10 살에서 12 살이 되기 전까지는 땀샘의 작용이 활발하지 않다. 아기들이나 어린 아이들은 땀을 흘리긴 하지만 나쁜 냄새를 풍기지 않는다.

위의 글을 다 읽었다면 다음 장으로 넘어가도 좋습니다. 필요하면 한 번 더 읽어도 좋습니다. 하지만, 다음 장으로 넘어간 후에는 다시 이곳으로 돌아올 수 없습니다.

아래 문장들을 주의 깊게 읽으세요. 만약 문장의 내용이 앞에서 읽은 글의 내용에 비추어 볼 때 맞으면 ‘예’에 동그라미를 치고, 틀리면 ‘아니오’에 동그라미를 치세요. 내용을 확인하기 위해 앞장으로 돌아가지 마세요.

1. 사람들은 겨울보다 여름에 더 많은 악취를 풍긴다. (예, 아니오)
2. 코끼리는 체온을 내리기 위해 물과 바람을 이용한다. (예, 아니오)
3. 땀샘이 없어도 땀을 흘리는 동물들이 있다. (예, 아니오)
4. 땀이 나면 바로 땀냄새가 나기 시작한다. (예, 아니오)
5. 박테리아가 없으면 땀에서는 냄새가 나지 않는다. (예, 아니오)
6. 10-12 살 이전에는 땀을 잘 흘린다. (예, 아니오)
7. 땀을 많이 흘리지 않는 사람은 땀을 많이 흘리는 사람에 비해 냄새가 적게 난다.
(예, 아니오)
8. 개가 빠르게 숨을 쉴 때 입을 통해 땀이 빠져 나간다. (예, 아니오)
9. 운동 후 샤워를 하는 이유는 땀을 씻어 박테리아의 활동을 돕기 위한 것이다.
(예, 아니오)
10. 땀샘이 있는 동물들은 모두 땀을 흘린다. (예, 아니오)
11. 어린아이들은 어른들에 비해 땀을 많이 흘리지 않는다. (예, 아니오)
12. 코끼리는 귀 밑에서 땀을 흘린다. (예, 아니오)
13. 개가 입을 벌리고 혀를 내밀어 숨을 쉬는 것은 몸의 온도를 조절하기 위한 것이다.
(예, 아니오)
14. 코끼리는 땀이 분비되는 기관을 가지고 있지 않다. (예, 아니오)
15. 개가 혀를 내밀어 빠르게 숨쉬는 모습은 겨울에 가장 많이 볼 수 있다. (예, 아니오)
16. 땀냄새가 나는 것은 박테리아가 땀을 분해하기 때문이다. (예, 아니오)

모든 문제에 ‘예’ 또는 ‘아니오’로 답을 했다면 다음 장으로 넘어가도 좋습니다. 다음 장으로 넘어간 후에는 다시 이곳으로 돌아올 수 없습니다.

아래 글을 주의 깊게 읽어보세요.

바다 동물들이 사라지고 있다.

지구 상에 존재하는 가장 큰 바다 동물들인 백상어와 흰수염고래의 수가 최근 들어 급격히 줄어들고 있다. 사람들이 백상어와 흰수염고래를 너무 많이 죽였기 때문이다. 사람들은 백상어와 흰수염고래의 먹이가 되는 동물들을 죽였다. 또한 해양오염으로 인해 이들의 서식지¹가 파괴되었다.

백상어는 따뜻한 바다가 있는 곳이면 어디서나 산다. 이 거대한 물고기는 큰 물고기, 돌고래, 바다거북, 바다표범을 먹고 살며, 심지어 사람까지도 공격하기 때문에 사람들은 백상어를 두려워한다. 백상어는 일반적인 어류²와는 달리 새끼를 낳는다. 하지만 새끼에게 먹일 젖을 만들어내지는 않기 때문에 새끼는 태어난 즉시 다른 동물들을 먹어야만 살 수 있다.

흰수염고래는 지구상에 가장 큰 동물이다. 만일 육지동물이 흰수염고래 만큼 크다면 움직일 수조차 없을 것이다. 흰수염고래는 물이 그들의 몸을 떠받쳐 주기 때문에 그만큼 크게 자랄 수 있다. 흰수염고래는 100 살까지 살 수 있는 포유류이며 전세계 바다에서 발견된다. 흰수염고래도 백상어처럼 다른 동물들을 먹고 살지만 이 거대한 동물이 먹는 것은 크릴이다. 크릴은 새우처럼 보이는 매우 작은 동물이다. 백상어와 달리 흰수염고래는 결코 사람을 공격하지 않는다. 그러나 사람들은 흰수염고래의 체지방, 기름, 고기를 얻기 위해 이들을 많이 죽였다.

백상어와 흰수염고래는 멸종위기에 처해 있다. 아무도 이 흥미로운 바다 동물들이 완전히 사라지길 원하지 않기 때문에 사람들은 이들을 멸종 위기에서 구해내기 위해 애쓰고 있다.

위의 글을 다 읽었다면 다음 장으로 넘어가도 좋습니다. 필요하다면 한 번 더 읽어도 좋습니다. 하지만, 다음 장으로 넘어간 후에는 다시 이곳으로 돌아올 수 없습니다.

¹ 동물이나 식물이 살아가는 장소

² 물고기 종류

아래 문장들을 주의 깊게 읽으세요. 만약 문장의 내용이 앞에서 읽은 글의 내용에 비추어 볼 때 맞으면 ‘예’에 동그라미를 치고, 틀리면 ‘아니오’에 동그라미를 치세요. 내용을 확인하기 위해 앞장으로 돌아가지 마세요.

17. 백상어와 흰수염고래에게 가장 강력한 적은 사람이다. (예, 아니오)
18. 어류들 중 어떤 물고기들은 젖으로 새끼를 키운다. (예, 아니오)
19. 백상어는 흰수염고래에 비해 훨씬 더 넓은 지역에 퍼져서 살아간다. (예, 아니오)
20. 백상어는 몸집이 큰 바다 동물들을 먹고 산다. (예, 아니오)
21. 흰수염고래의 고기와 기름 등은 인간에게 유용하게 쓰여져 왔다. (예, 아니오)
22. 북극이나 남극의 바다에서 백상어를 쉽게 볼 수 있다. (예, 아니오)
23. 지구에서 사는 동물들 중 흰수염고래가 가장 크다. (예, 아니오)
24. 백상어는 일반 어류처럼 알을 낳고 그 알에서 새끼가 태어난다. (예, 아니오)
25. 바다가 오염되면서 백상어와 흰수염고래가 살 수 있는 곳이 줄어들었다. (예, 아니오)
26. 대부분의 흰수염고래는 주로 따뜻한 바다에서 산다. (예, 아니오)
27. 흰수염고래는 살기 위해 많은 양의 크릴을 먹어야 한다. (예, 아니오)
28. 새끼 백상어는 태어난 후부터 어느 정도 자랄 때까지 젖을 먹는다. (예, 아니오)

모든 문제에 ‘예’ 또는 ‘아니오’로 답을 했다면 다음 장으로 넘어가도 좋습니다. 다음 장으로 넘어간 후에는 다시 이곳으로 돌아올 수 없습니다.

아래 글을 주의 깊게 읽어보세요.

중력: 보이지 않는 힘

위로 올라간 물체는 아래로 떨어진다. 왜 그럴까? 물체를 아래로 끌어당기는 보이지 않는 힘, 즉 중력 때문이다. 뉴턴은 사과나무에서 사과가 떨어지는 모습을 지켜본 후 이 때 작용하는 힘을 중력이라고 이름 지었다. 뉴턴은 물체는 항상 아래로 떨어진다는 사실을 깨달았다. 어떠한 물체도 결코 위로 떨어지지 않는다.

이후, 뉴턴은 중력으로 인해 지구에서 발생하는 중요한 현상들을 발견했다. 달의 중력이 지구 표면에 있는 물을 끌어당기므로 바다에 조수간만이 생긴다. 지구 중력은 지구를 둘러싸고 있는 공기가 우주 공간으로 날아가 버리는 것을 막아준다. 날씨는 공기의 변화에 의해 발생한다. 만일 공기가 없으면 지구에 날씨가 존재하지 않을 것이다. 또한 중력은 우리가 우주로 날아가는 것을 막아준다. 지구와 지구 주변의 행성들이 태양 주위를 도는 것도 중력의 작용이다. 달이 지구 주위를 도는 것도 중력의 영향 때문이다. 지구는 결코 달과 부딪히지 않으며, 그런 일은 일어나지 말아야 한다. 우리는 중력을 볼 수도 없고 만질 수도 없다.

지구로부터 먼 우주공간으로 날아갈수록 중력의 영향은 줄어든다. 사람들은 우주선 밖으로 나갈 때 자신들을 우주선과 끈으로 연결한다. 그렇게 하지 않으면 우주를 떠다니다가 멀리 사라져 버릴 것이다.

모든 물체는 다른 물체를 잡아당기는 힘을 가지고 있다. 물체가 커질수록 중력도 증가한다. 목성은 모든 태양계 행성들을 합친 것보다도 크다. 그래서 목성은 다른 행성들보다 더 큰 중력을 가진다. 지구도 상당히 크다. 따라서, 지구 중력도 매우 크기 때문에 지구 주변을 통과하는 운석들이 지구 안으로 끌려들어 온다. 다행스럽게도 지구 속으로 끌려들어 온 대부분의 운석들은 대기 중에서 불타 없어진다. 그렇지 않으면 우리는 큰 재앙을 만나게 될 것이다.

위의 글을 다 읽었다면 다음 장으로 넘어가도 좋습니다. 필요하다면 한 번 더 읽어도 좋습니다. 하지만, 다음 장으로 넘어간 후에는 다시 이곳으로 돌아올 수 없습니다.

아래 문장들을 주의 깊게 읽으세요. 만약 문장의 내용이 앞에서 읽은 글의 내용에 비추어 볼 때 맞으면 ‘예’에 동그라미를 치고, 틀리면 ‘아니오’에 동그라미를 치세요. 내용을 확인하기 위해 앞장으로 돌아가지 마세요.

- 29. 지구에 중력이 존재하지 않는다면 지구 내에 날씨의 변화도 없을 것이다. (예, 아니오)
- 30. 태양계 행성들 중 지구가 가장 큰 중력을 가지고 있다. (예, 아니오)
- 31. 태양과 태양 주위를 도는 행성들 간에는 중력이 작용한다. (예, 아니오)
- 32. 지구 주변을 떠 다니는 운석들이 지구를 강하게 끌어 당긴다. (예, 아니오)
- 33. 큰 물체일수록 다른 물체를 끌어 당기는 힘이 크다. (예, 아니오)
- 34. 달이 지구 쪽으로 끌려 들어오지 않는 것은 달과 지구의 크기가 같기 때문이다.
(예, 아니오)
- 35. 목성은 태양계 행성들 중 가장 크다. (예, 아니오)
- 36. 지구 내에 있는 공기는 중력의 영향을 받지 않는다. (예, 아니오)
- 37. 사과가 아래로 떨어지는 것은 지구가 사과를 당기는 힘이 사과가 지구를 당기는 힘보다
크기 때문이다. (예, 아니오)
- 38. 지구에 중력이 없으면 사람은 지구 안에서 떠 있을 수 있다. (예, 아니오)
- 39. 공중에 계속 떠 있기 위해서는 중력보다 큰 힘을 필요로 한다. (예, 아니오)
- 40. 사람과 사람 사이에는 서로 끌어 당기는 힘, 즉 중력이 작용하지 않는다. (예, 아니오)
- 41. 중력은 물체들 끼리 서로 끌어당기는 눈에 보이지 않는 힘이다. (예, 아니오)
- 42. 달이 지구 가까이 다가오면 달과 가까운 곳에 위치한 바다에서는 썰물이 생길 것이다.
(예, 아니오)
- 43. 지구로부터 멀어져 우주 공간으로 날아가면 중력의 영향이 적어진다. (예, 아니오)
- 44. 지구 이외의 행성들에서 날씨 변화가 없는 것은 중력이 작기 때문이다. (예, 아니오)

모든 문제에 ‘예’ 또는 ‘아니오’로 답을 했다면 다음 장으로 넘어가도 좋습니다. 다음 장으로 넘어간 후에는 다시 이곳으로 돌아올 수 없습니다.

아래 글을 주의 깊게 읽어보세요.

동물들의 분비물

스컹크의 악취는 동물이 풍기는 냄새들 중 가장 강력하다고 알려져 있다. 모든 포유류는 화학물질을 만들어내는 특별한 분비샘을 갖고 있다. 스킨크는 꼬리 근처에 있는 분비샘에서 냄새를 뿜어낸다. 이 냄새는 더 큰 동물들로부터 스킨크 자신을 보호해준다. 스킨크가 냄새를 분사³하면 개나 늑대들은 대개 스킨크를 피한다. 스킨크의 분비물이 풍기는 지독한 냄새는 다른 동물들을 구역질 나게 한다. 스킨크는 적을 만날 때 분비물을 내뿜는 자세를 취한다. 적을 향해 엉덩이를 돌려대고 꼬리를 높이 쳐든다. 사실 스킨크는 분비물을 발사하고 싶어하지 않는다. 그렇지만 적들은 그 사실을 모른다.

대부분의 포유류는 냄새를 이용하여 자신들의 영역을 표시한다. 포유류는 땅과 나무에 자신들의 냄새를 남겨둔다. 암곰은 3.2 - 9.7 km² 반경에 냄새를 남겨둔다. 수곰의 영역은 그보다 훨씬 넓다. 다른 곰의 영역에 들어간 곰들은 그 곳에서 풍기는 다른 곰의 냄새 때문에 그들이 남의 영역에 침입했다는 사실을 알아차린다. 수사슴이 머리를 나무 줄기에 문지르는 것은 잘 알려진 행동이다. 과거에는 이것이 새로운 뿔을 자라도록 하기 위해 오래된 뿔을 떼어내기 위한 행동이라고 여겨졌다. 하지만 이것은 사슴이 자신의 영역을 표시하는 행동이다. 사슴이 머리를 문지를 때 분비샘에서 화학물질이 나온다. 화학물질이 풍기는 냄새는 땅과 나무에 남아 있게 된다.

위의 글을 다 읽었다면 다음 장으로 넘어가도 좋습니다. 필요하다면 한 번 더 읽어도 좋습니다. 하지만, 다음 장으로 넘어간 후에는 다시 이곳으로 돌아올 수 없습니다.

³ 액체나 기체에 압력을 가하여 뿜어 내보냄

아래 문장들을 주의 깊게 읽으세요. 만약 문장의 내용이 앞에서 읽은 글의 내용에 비추어 볼 때 맞으면 ‘예’에 동그라미를 치고, 틀리면 ‘아니오’에 동그라미를 치세요. 내용을 확인하기 위해 앞장으로 돌아가지 마세요.

45. 스컹크는 적이 알아차리기 전에 갑자기 분비물을 발사해서 적을 놀라게 한다.
(예, 아니오)
46. 곰은 넓은 영역을 돌아다니기 때문에 자주 자신의 영역을 찾지 못한다. (예, 아니오)
47. 스컹크의 적들은 스컹크가 자신들을 향해 꼬리를 치켜들면 곧 분비물을 발사할 것으로 생각한다. (예, 아니오)
48. 수사슴의 분비물은 땅과 나무에 남아 독특한 냄새를 풍긴다. (예, 아니오)
49. 암곰은 새끼를 키우기 위해 수곰보다 넓은 영역에서 생활한다. (예, 아니오)
50. 모든 포유류는 고유한 분비샘에서 화학물질을 만들어낸다. (예, 아니오)
51. 적을 만난 스컹크는 언제나 분비물을 내뿜어 적을 쫓아낸다. (예, 아니오)
52. 동물의 분비물은 적으로부터 자신을 지키거나 영역을 표시하기 위해 사용된다.
(예, 아니오)
53. 수사슴이 나무 줄기에 머리를 문지르는 것은 암사슴을 불러들이기 위해서이다.
(예, 아니오)
54. 동물들이 더 큰 동물로부터 자신을 지키는 방법 중의 하나는 악취를 풍기는 것이다.
(예, 아니오)
55. 스컹크의 냄새 분비샘은 꼬리 근처에 있으며 이를 통해 냄새를 분비한다. (예, 아니오)
56. 같은 종류의 동물들이 분비하는 물질에서는 항상 똑 같은 냄새가 난다. (예, 아니오)

문제를 푸느라 수고했습니다!

다음 장으로 넘어가면 요약하기 문제가 나옵니다. 다음 장으로 넘어간 후에는 이곳으로 다시 돌아올 수 없습니다.

아래의 글을 다시 한 번 주의 깊게 읽어보세요. 다 읽었으면 뒷면에 글의 내용을 요약해 보세요. 요약하기란 중요한 내용들을 찾아내어 짜임새 있게 정리하는 것을 말합니다.

바다 동물들이 사라지고 있다.

지구 상에 존재하는 가장 큰 바다 동물들인 백상어와 흰수염고래의 수가 최근 들어 급격히 줄어들고 있다. 사람들이 백상어와 흰수염고래를 너무 많이 죽였기 때문이다. 사람들은 백상어와 흰수염고래의 먹이가 되는 동물들을 죽였다. 또한 해양오염으로 인해 이들의 서식지⁴가 파괴되었다.

백상어는 따뜻한 바다가 있는 곳이면 어디서나 산다. 이 거대한 물고기는 큰 물고기, 돌고래, 바다거북, 바다표범을 먹고 살며, 심지어 사람까지도 공격하기 때문에 사람들은 백상어를 두려워한다. 백상어는 일반적인 어류⁵와는 달리 새끼를 낳는다. 하지만 새끼에게 먹일 젖을 만들어내지는 않기 때문에 새끼는 태어난 즉시 다른 동물들을 먹어야만 살 수 있다.

흰수염고래는 지구상에 가장 큰 동물이다. 만일 육지동물이 흰수염고래 만큼 크다면 움직일 수조차 없을 것이다. 흰수염고래는 물이 그들의 몸을 떠받쳐 주기 때문에 그만큼 크게 자랄 수 있다. 흰수염고래는 100 살까지 살 수 있는 포유류이며 전세계 바다에서 발견된다. 흰수염고래도 백상어처럼 다른 동물들을 먹고 살지만 이 거대한 동물이 먹는 것은 크릴이다. 크릴은 새우처럼 보이는 매우 작은 동물이다. 백상어와 달리 흰수염고래는 결코 사람을 공격하지 않는다. 그러나 사람들은 흰수염고래의 체지방, 기름, 고기를 얻기 위해 이들을 많이 죽였다.

백상어와 흰수염고래는 멸종위기에 처해 있다. 아무도 이 흥미로운 바다 동물들이 완전히 사라지길 원하지 않기 때문에 사람들은 이들을 멸종 위기에서 구해내기 위해 애쓰고 있다.

⁴ 동물이나 식물이 살아가는 장소

⁵ 물고기 종류

앞에서 읽은 글 ‘바다 동물들이 사라지고 있다’를 요약해 보세요. 요약하기란 중요한 내용들을 찾아서 짜임새 있게 정리하는 것을 말합니다. 단, 앞에 나온 글을 보기 위해 절대로 앞장으로 돌아가지 마세요.

Posttest Materials

이 검사는 글을 읽고 그 내용을 얼마나 잘 이해하고 있는지를 평가하기 위한 것입니다. 여러분은 한 번에 하나씩 모두 4 개의 글을 읽게 될 것입니다. 각각의 글을 주의 깊게 읽고 주어진 문제에 답해 보세요.

수액을 찾아서

수액⁶은 물, 당분, 무기물로 구성된 혼합물이다. 수액은 식물의 줄기 속에 있는 관을 통하여 뿌리에서 잎으로 이동한다. 어떤 식물은 부러졌을 때 수액을 분비하여 스스로를 치료한다. 많은 식물들이 달콤한 수액을 만들어내며 사람과 동물은 이러한 수액을 좋아한다.

수액을 좋아하는 대표적인 동물은 북미산 딱따구리이다. 북미산 딱따구리는 미국 남부 지방에서 겨울을 나고 봄이 되면 수액을 찾아 북쪽으로 이동한다. 이 새는 강한 부리를 이용하여 나무 줄기에 작고 둥근 구멍을 판다. 그리고 긴 혀를 이용하여 끈적한 수액을 핥아 먹는다. 다른 새들과 곤충들도 북미산 딱따구리가 판 구멍 주변에 몰래 찾아와 함께 수액을 먹는다.

캐나다와 미국에서 자라는 사탕단풍나무는 무색의 달콤한 수액을 만들어낸다. 사탕단풍나무의 수액은 겨우내 나무 뿌리에 저장되어 있다가 이른 봄 낮에는 따뜻하고 밤에는 추워지는 날씨가 계속되면 줄기를 통해 위로 이동한다.

사탕단풍나무 수액에서 단풍나무 설탕을 최초로 얻어낸 사람들은 인디언들이다. 인디언들은 단풍나무 설탕을 과일, 야채, 곡식, 또는 물고기에 발라서 먹었다.

위의 글을 다 읽었다면 다음 장으로 넘어가도 좋습니다. 필요하면 한 번 더 읽어도 좋습니다. 하지만, 다음 장으로 넘어간 후에는 다시 이곳으로 돌아올 수 없습니다.

⁶ 수액: 나무에서 분비되는 액체.

아래 문장들을 주의 깊게 읽으세요. 만약 문장의 내용이 앞에서 읽은 글의 내용에 비추어 볼 때 맞으면 ‘예’에 동그라미를 치고, 틀리면 ‘아니오’에 동그라미를 치세요. 내용을 확인하기 위해 앞장으로 돌아가지 마세요.

1. 북미산 딱따구리는 자신이 뚫어 놓은 구멍을 다른 새와 곤충이 접근하지 못하게 막아 놓는다. (예, 아니오)
2. 미국에서 사탕단풍나무가 많이 자라는 곳은 북부 지역이다. (예, 아니오)
3. 식물의 줄기는 양분을 저장하는 창고 역할을 한다. (예, 아니오)
4. 북미산 딱따구리는 부리로 나무에 구멍을 뚫어 혀로 수액을 빨아 먹는다. (예, 아니오)
5. 밤낮의 기온이 모두 높아질 때 사탕단풍나무의 수액은 뿌리에서 잎으로 이동한다.
(예, 아니오)
6. 식물의 줄기에는 물과 양분이 이동하는 통로가 있다. (예, 아니오)
7. 사탕단풍나무 수액은 12월에서 1월 사이에 많이 얻을 수 있다. (예, 아니오)
8. 식물이 만드는 달콤한 수액은 사람과 여러 동물들이 좋아하는 음식이다. (예, 아니오)
9. 인디언들은 단풍나무 수액을 이용하여 약을 만들었다. (예, 아니오)
10. 인디언들은 단풍나무 수액을 처음 사용하기 시작했다. (예, 아니오)
11. 미국 북부 지역과 캐나다는 겨울에 밤과 낮의 기온 차이가 심하다. (예, 아니오)
12. 식물에 상처가 나면 그 부분에서 많은 수액을 잃어버리기 때문에 약해진다.
(예, 아니오)
13. 식물의 뿌리와 잎은 관을 통하여 연결되어 있다. (예, 아니오)
14. 인디언들은 단풍나무 수액을 다른 음식에 곁들여 먹었다. (예, 아니오)
15. 밤낮의 기온 차이가 크지 않으면 사탕단풍나무 수액은 뿌리에 머물러 있을 것이다.
(예, 아니오)
16. 북미산 딱따구리는 사탕단풍나무가 많이 자라는 미국 북부지방에 사는 텃새이다.
(예, 아니오)

모든 문제에 ‘예’ 또는 ‘아니오’로 답을 했다면 다음 장으로 넘어가도 좋습니다. 다음 장으로 넘어간 후에는 다시 이곳으로 돌아올 수 없습니다.

아래 글을 주의 깊게 읽어보세요.

보아뱀

보아뱀은 뱀의 일종이다. 뱀은 도마뱀, 거북과 함께 파충류에 속한다. 그러나 도마뱀이나 거북과는 달리 뱀은 다리가 없다. 그래서 이동하기 위해 몸을 말았다 펴기를 반복해야 한다.

모든 파충류가 그렇듯이 보아뱀은 변온동물⁷이다. 변온동물들은 따뜻한 곳에서만 살아갈 수 있다. 대부분의 보아뱀들은 중앙아메리카나 남아메리카의 열대우림에 산다.

보아뱀은 열은 갈색 또는 분홍색을 띠고 있다. 보아뱀의 몸 색깔은 열대우림과 잘 어울리기 때문에 열대우림 속에서 보아뱀을 발견하기란 쉽지 않다.

보아뱀은 고기를 먹고 사는 육식동물이다. 어린 보아뱀은 작은 쥐를 먹고 산다. 다 자란 보아뱀은 쥐를 먹기도 하지만 쥐보다 더 큰 동물들도 잡아 먹는다. 원숭이나 돼지같이 큰 동물들도 어린 보아뱀의 먹이가 된다.

보아뱀은 먹잇감을 잡은 후 그것들이 숨을 멈출 때까지 조인다. 그 다음 통째로 삼켜버린다.

위의 글을 다 읽었다면 다음 장으로 넘어가도 좋습니다. 필요하면 한 번 더 읽어도 좋습니다. 하지만, 다음 장으로 넘어간 후에는 다시 이곳으로 돌아올 수 없습니다.

⁷외부 환경의 온도에 따라서 체온이 변화하는 동물

아래 문장들을 주의 깊게 읽으세요. 만약 문장의 내용이 앞에서 읽은 글의 내용에 비추어 볼 때 맞으면 ‘예’에 동그라미를 치고, 틀리면 ‘아니오’에 동그라미를 치세요. 내용을 확인하기 위해 앞장으로 돌아가지 마세요.

17. 뱀, 도마뱀, 거북 등은 주변의 온도가 낮아지면 활동이 둔해진다. (예, 아니오)

18. 보아뱀은 다른 동물들을 잡아 먹고 산다. (예, 아니오)

19. 열대우림에 사는 보아뱀의 몸 색깔은 주변 환경과 잘 구분된다. (예, 아니오)

20. 보아뱀은 먹이를 죽이기 위해 매우 강한 독을 사용한다. (예, 아니오)

21. 어른이 된 보아뱀은 더 이상 쥐를 잡아먹지 않는다. (예, 아니오)

22. 거북, 도마뱀, 뱀은 파충류의 일종이다. (예, 아니오)

23. 도마뱀이나 거북은 이동할 때 뱀에 비해 더 많은 근육들을 사용해야 한다.

(예, 아니오)

24. 동물들의 보호색은 대부분 주변 환경의 색깔과 비슷하다. (예, 아니오)

25. 보아뱀은 주변 온도에 상관없이 체온이 일정하다. (예, 아니오)

26. 열대우림에는 많은 종류의 파충류들이 살고 있다. (예, 아니오)

27. 뱀은 몸을 말았다 펴기를 되풀이하면서 이동한다. (예, 아니오)

28. 보아뱀은 더운 지역과 추운 지역 모두에 고르게 퍼져서 살고 있다. (예, 아니오)

모든 문제에 ‘예’ 또는 ‘아니오’로 답을 했다면 다음 장으로 넘어가도 좋습니다. 다음 장으로 넘어간 후에는 다시 이곳으로 돌아올 수 없습니다.

아래 글을 주의 깊게 읽어보세요.

유전자

여러분은 곱슬머리인가요? 여러분은 다른 아이들보다 키가 크나요? 이런 특징들은 여러분들이 태어나기 전에 이미 결정되어 있습니다. 이런 특징들은 부모님으로부터 물려받은 것이랍니다. 부모님이 가지고 계신 특징들은 유전자를 통해 여러분들에게 전달되어지지요.

유전자 속에 있는 정보에 의해 푸른색 눈이나, 갈색 눈이냐가 결정됩니다. 유전자는 여러분의 키가 얼마나 자랄 지, 그리고 머리털 색깔은 어떨 지 말해주지요. 여러분 유전자의 절반은 엄마로부터, 나머지 반은 아빠로부터 물려받은 것입니다. 부모님으로부터 반반씩 물려받은 유전자가 합쳐져 여러분 고유의 유전자를 이루게 되지요. 보통 형제, 자매들은 서로 닮은 점이 많지만, 부모님으로부터 어떤 유전자를 물려받았느냐에 따라 약간씩 서로 다른 모습을 갖게 되지요.

유전자는 크게 우성과 열성으로 나누어집니다. 우성 유전자는 쉽게 드러나며 우리 주변에서 흔히 볼 수 있습니다. 갈색 눈은 푸른색 눈에 비해 우성이지요. 열성 유전자는 우성 유전자에 비해 드물게 나타납니다. 금발과 같은 옅은 색의 머리카락은 열성 유전자입니다. 우리가 길거리에서 흔히 볼 수 있는 머리카락은 우성 유전자인 짙은 색 머리카락입니다. 주변에 있는 사람들의 눈과 머리카락의 색깔을 살펴보세요.

여러분들이 지금과 같은 모습을 갖게 된 데는 유전자의 영향이 큼니다. 하지만 유전자가 여러분들이 갖고 있는 모든 특징을 설명해주지는 못합니다. 여러분들이 얼마나 빠른지 또는 얼마나 힘이 센지는 유전자의 영향을 받습니다. 그러나 달리기나 수영을 잘 하는 법, 스케이트를 잘 타는 법은 여러분 스스로 배워야 합니다.

위의 글을 다 읽었다면 다음 장으로 넘어가도 좋습니다. 필요하면 한 번 더 읽어도 좋습니다. 하지만, 다음 장으로 넘어간 후에는 다시 이곳으로 돌아올 수 없습니다.

아래 문장들을 주의 깊게 읽으세요. 만약 문장의 내용이 앞에서 읽은 글의 내용에 비추어 볼 때 맞으면 ‘예’에 동그라미를 치고, 틀리면 ‘아니오’에 동그라미를 치세요. 내용을 확인하기 위해 앞장으로 돌아가지 마세요.

29. 유전자 속에는 눈의 색깔, 머리털의 색깔과 모양, 키에 대한 정보가 들어있다.

(예, 아니오)

30. 유전자 검사를 통해 부모와 자식의 관계를 밝혀낼 수 있다. (예, 아니오)

31. 쌍꺼풀 눈은 그렇지 않은 눈에 대해 우성유전자이다. (예, 아니오)

32. 사람이 현재 갖고 있는 모든 특징은 유전자에 의해 결정되었다. (예, 아니오)

33. 일란성 쌍둥이는 키가 비슷하게 자랄 것이다. (예, 아니오)

34. 짙은 색의 머리카락을 가진 사람의 수가 옅은 색의 머리카락을 가진 사람들의 수보다 많다. (예, 아니오)

35. 내가 가진 신체적 특징들 중 많은 것들은 유전자 속에 포함된 정보와 상관이 없다.

(예, 아니오)

36. 푸른색 눈을 가진 사람의 수는 갈색 눈을 가진 사람 수보다 많다. (예, 아니오)

37. 유전자 중에서 쉽게 드러나는 것은 우성, 잘 드러나지 않는 것은 열성 유전자이다.

(예, 아니오)

38. 할아버지와 할머니의 유전자는 손자, 손녀들에게 영향을 주지 않는다. (예, 아니오)

39. 푸른색 눈이나 짙은 색 머리카락은 갈색 눈이나 옅은 색 머리카락에 대하여 우성 유전자이다. (예, 아니오)

40. 한국인들에게서 곱슬머리는 우성유전자이다. (예, 아니오)

41. 유전자는 부모의 특징들을 다음 세대에게 전달하는 매개체이다. (예, 아니오)

42. 형제, 자매라고 해서 똑같은 유전자를 가지는 것은 아니다. (예, 아니오)

43. 유전자 정보를 분석하면 수영을 잘 하거나 스케이트를 잘 탈 것인지를 알 수 있다.

(예, 아니오)

44. 부모의 유전자를 연구하면 태어날 자녀들의 머리털 모양, 눈 색깔 등을 미리 알 수 있다. (예, 아니오)

모든 문제에 ‘예’ 또는 ‘아니오’로 답을 했다면 다음 장으로 넘어가도 좋습니다. 다음 장으로 넘어간 후에는 다시 이곳으로 돌아올 수 없습니다.

아래 글을 주의 깊게 읽어보세요.

달에서 얻어지는 에너지

바닷물이 정기적으로 밀려 들어왔다 빠져나가는 것을 조수라고 한다. 밀물⁸과 썰물⁹의 높이 차이는 부두의 벽면에 닿은 바닷물의 높이를 통해 알 수 있다. 밀물 때 부두에서 내려다보면 바닷물이 가깝게 보인다. 썰물 때에는 수면이 멀게 느껴진다. 무엇 때문에 수면의 높이가 달라질까? 바로 달 때문이다.

달이 지구 주위를 돌 때 달의 중력이 바닷물을 끌어당긴다. 이 힘이 바닷물의 움직임을 만든다. 이러한 물의 움직임을 조수라고 한다. 오래 전, 사람들은 지구가 살아있다고 믿었다. 그들은 조수가 생기는 것은 지구가 숨을 쉬고 있기 때문이라고 생각했다. 어떤 사람들은 달이 머리 위로 지나갈 때 밀물과 썰물이 생긴다는 것을 알았다. 하지만 달이 조수를 일으킨다는 사실은 1687년이 되어서야 정확하게 밝혀졌다.

달은 하루에 한 바퀴 지구를 돌기 때문에 하루에 두 차례 밀물과 썰물이 생긴다. 사람들은 달이 어떻게 움직이는지 알기 때문에 언제 밀물과 썰물이 되는 지 알 수 있다. 조수는 아주 일정하기 때문에 프랑스에서는 밀물과 썰물의 차이를 이용하여 전기를 만들어내는 발전소를 세웠다. 밀물 때 발전소 수문이 열리면 물이 안으로 몰려 든다. 물이 차면 수문이 닫힌다. 썰물 때 다른 수문이 열리고 저장된 물이 빠져나가면서 터빈을 통과한다. 이 때 터빈이 돌면서 전기를 만들어낸다. 조수를 이용하는 것은 전기를 만드는 좋은 방법이다. 그러나 조수를 이용하는 발전소를 세울 수 있는 곳은 그리 많지 않다.

위의 글을 다 읽었다면 다음 장으로 넘어가도 좋습니다. 필요하다면 한 번 더 읽어도 좋습니다. 하지만, 다음 장으로 넘어간 후에는 다시 이곳으로 돌아올 수 없습니다.

⁸하루 두 번씩 일정한 때 밀려 들어오는 바닷물

⁹바닷물이 밀려 나가서 해면이 낮아지는 현상

아래 문장들을 주의 깊게 읽으세요. 만약 문장의 내용이 앞에서 읽은 글의 내용에 비추어 볼 때 맞으면 ‘예’에 동그라미를 치고, 틀리면 ‘아니오’에 동그라미를 치세요. 내용을 확인하기 위해 앞장으로 돌아가지 마세요.

- 45. 달이 지구에 가까워질수록 바닷물을 끌어 당기는 힘이 강해진다. (예, 아니오)
- 46. 조수는 달이 태양 주위를 돌기 때문에 생기는 현상이다. (예, 아니오)
- 47. 바다는 밀물과 썰물 때 바닷물의 높이가 다르다. (예, 아니오)
- 48. 밀물이 생기는 곳에서는 항상 밀물만 생기고 썰물이 생기는 곳에서는 항상 썰물만 생긴다. (예, 아니오)
- 49. 어떤 사람들은 지구가 숨을 들이마시고 내쉬기 때문에 조수가 생긴다고 생각했다. (예, 아니오)
- 50. 달에 바다가 있다면 그 곳에서도 밀물과 썰물이 생길 것이다. (예, 아니오)
- 51. 아주 많은 곳에서 밀물과 썰물의 차이를 이용하여 전기를 얻고 있다. (예, 아니오)
- 52. 프랑스 바닷가에는 밀물과 썰물의 차이가 크다. (예, 아니오)
- 53. 밀물과 썰물은 불규칙하게 일어나기 때문에 예측하기 어렵다. (예, 아니오)
- 54. 지구에서 달과 가까운 곳에서는 썰물이 생긴다. (예, 아니오)
- 55. 조수란 바다에서 밀물과 썰물이 반복해서 일어나는 현상이다. (예, 아니오)
- 56. 농부들은 어부들에 비해 달의 움직임에 대해 더 민감했을 것이다. (예, 아니오)

문제를 푸느라 수고했습니다!

다음 장으로 넘어가면 요약하기 문제가 나옵니다. 다음 장으로 넘어간 후에는 이곳으로 다시 돌아올 수 없습니다.

아래의 글을 다시 한 번 주의 깊게 읽어보세요. 다 읽었으면 뒷면에 글의 내용을 요약해 보세요. 요약하기란 중요한 내용들을 찾아내어 짜임새 있게 정리하는 것을 말합니다.

보아뱀

보아뱀은 뱀의 일종이다. 뱀은 도마뱀, 거북과 함께 파충류에 속한다. 그러나 도마뱀이나 거북과는 달리 뱀은 다리가 없다. 그래서 이동하기 위해 몸을 말았다 펴기를 반복해야 한다.

모든 파충류가 그렇듯이 보아뱀은 변온동물¹⁰이다. 변온동물들은 따뜻한 곳에서만 살아갈 수 있다. 대부분의 보아뱀들은 중앙아메리카나 남아메리카의 열대우림에 산다.

보아뱀은 열은 갈색 또는 분홍색을 띠고 있다. 보아뱀의 몸 색깔은 열대우림과 잘 어울리기 때문에 열대우림 속에서 보아뱀을 발견하기란 쉽지 않다.

보아뱀은 고기를 먹고 사는 육식동물이다. 어린 보아뱀은 작은 쥐를 먹고 산다. 다 자란 보아뱀은 쥐를 먹기도 하지만 쥐보다 더 큰 동물들도 잡아 먹는다. 원숭이나 돼지같이 큰 동물들도 어린 보아뱀의 먹이가 된다.

보아뱀은 먹잇감을 잡은 후 그것들이 숨을 멈출 때까지 조인다. 그 다음 통째로 삼켜버린다.

¹⁰외부 환경의 온도에 따라서 체온이 변화하는 동물

앞에서 읽은 글 ‘보아뱀’을 요약해 보세요. 요약하기란 중요한 내용들을 찾아서 짜임새 있게 정리하는 것을 말합니다. 단, 앞에 나온 글을 보기 위해 절대로 앞장으로 돌아가지 마세요.

Follow-up Test Materials

이 검사는 글을 읽고 그 내용을 얼마나 잘 이해하고 있는지를 평가하기 위한 것입니다. 여러분은 한 번에 하나씩 모두 4 개의 글을 읽게 될 것입니다. 각각의 글을 주의 깊게 읽고 주어진 문제에 답해 보세요.

왜 어떤 날은 꿈을 꾸고 어떤 날은 꾸지 않을까?

꿈에 대해 모든 것을 알고 있는 사람은 아무도 없다. 하지만 일부분은 알려져 있다. 모든 사람들이 꿈을 꾼다. 대부분의 사람들은 매일 밤 1 시간 30 분에서 2 시간 정도 꿈을 꾼다. 이러한 사실은 잠자고 있는 사람을 연구함으로써 알게 되었다. 뇌는 꿈을 꾸는 동안 활동한다. 이 때 뇌 속에서 약한 전류가 생기며 이러한 전류는 머리 표면에서 감지¹¹된다. 과학자들은 뇌에서 발생하는 이러한 전기 활동을 뇌전도라고 부른다.

사람이 잠잘 때 나타나는 또 하나의 현상은 눈이 빠른 속도로 움직이는 것, 즉 급속 안구운동이다. 꿈, 뇌전도, 급속안구운동은 동시에 일어난다. 자는 사람을 깨워서 물어보지 않더라도 눈의 움직임을 관찰하면 꿈을 꾸고 있는 지 아닌지를 알 수 있다.

사람들이 꿈꿀 때 뇌에서 나타나는 전기 활동과 똑같은 활동이 거의 모든 포유류¹²와 조류¹³에서도 발견되었다. 이런 사실을 바탕으로 과학자들은 다른 동물들도 사람과 마찬가지로 꿈을 꾼다고 생각하게 되었다.

꿈꾸는 동안 잠에서 깨어나지 않는다면 우리는 그 꿈을 기억하지 못한다. 잠에서 깨어난 후 꿈을 꾸지 않았다는 생각이 드는 것은 급속 안구 운동이 지난 후 깨어났기 때문이다.

위의 글을 다 읽었다면 다음 장으로 넘어가도 좋습니다. 필요하다면 한 번 더 읽어도 좋습니다. 하지만, 다음 장으로 넘어간 후에는 다시 이곳으로 돌아올 수 없습니다.

¹¹ 느끼어 앓

¹² 젖으로 새끼를 키우는 동물

¹³ 날짐승

아래 문장들을 주의 깊게 읽으세요. 만약 문장의 내용이 앞에서 읽은 글의 내용에 비추어 볼 때 맞으면 ‘예’에 동그라미를 치고, 틀리면 ‘아니오’에 동그라미를 치세요. 내용을 확인하기 위해 앞장으로 돌아가지 마세요.

1. 잠자는 동안에 뇌는 활동하지 않는다. (예, 아니오)
2. 꿈꿀 때는 언제나 급속안구운동이 일어난다. (예, 아니오)
3. 매일 꿈을 꾸는 사람들의 수는 많지 않다. (예, 아니오)
4. 개나 고양이들도 잠잘 때 눈이 빠른 속도로 움직인다. (예, 아니오)
5. 현재까지 꿈에 관한 대부분의 사실들이 밝혀졌다. (예, 아니오)
6. 뇌 속에서 일어나는 전기활동을 감지하기 위해서는 정밀한 기계가 필요하다.
(예, 아니오)
7. 포유류와 조류들도 잠잘 때 뇌에서 전기 활동이 일어난다. (예, 아니오)
8. 잠을 자고 있는 동안 계속해서 뇌전도가 일어난다. (예, 아니오)
9. 꿈을 기억하지 못하는 것은 기억력에 문제가 있기 때문이 아니다. (예, 아니오)
10. 잠잘 때 눈이 빠르게 움직이는 것은 잠에서 깨어나고 있다는 표시이다. (예, 아니오)
11. 비둘기는 잠을 안 자기 때문에 급속안구운동을 하지 않는다. (예, 아니오)
12. 급속 안구운동이 지난 후에 잠에서 깨면 꿈을 꾸지 않았다는 생각이 든다.
(예, 아니오)
13. 꿈에 관한 연구는 계속해서 이루어지고 있다. (예, 아니오)
14. 사람들은 항상 급속 안구 운동이 지난 후에 깨어난다. (예, 아니오)
15. 꿈에 대한 연구는 잠자는 사람들을 통해 이루어진다. (예, 아니오)
16. 꿈을 꾸고 있을 때 뇌 속에서 강력한 전기가 발생한다. (예, 아니오)

모든 문제에 ‘예’ 또는 ‘아니오’로 답을 했다면 다음 장으로 넘어가도 좋습니다. 다음 장으로 넘어간 후에는 다시 이곳으로 돌아올 수 없습니다.

아래 글을 주의 깊게 읽어보세요.

꿈틀거리는 벌레들

이것은 땅 속에서 살며 새들이 아주 좋아하는 음식이다. 이것이 무엇일까? 지렁이다. 대부분의 지렁이들은 두꺼운 갈색 실같이 보인다. 지렁이의 크기는 다양하다. 어떤 지렁이들은 2.5 센티미터 이하로 매우 짧다. 이에 반해 3 미터가 넘는 지렁이도 있다. 지렁이는 보거나 들을 수 없다. 그럼 지렁이들은 어떻게 돌아다닐 수 있을까? 지렁이는 몸에 닿는 느낌으로 길을 안다.

지렁이는 꿈틀거리면서 흙 사이를 돌아다닌다. 이렇게 함으로써 토양을 섞어 놓는다. 식물들은 토양이 섞인 곳에서 잘 자란다.

비가 내린 후 이곳 저곳에서 지렁이를 볼 수 있다. 왜일까? 지렁이는 피부를 통해 숨을 쉰다. 땅 속에서 살아가는 지렁이들은 흙 알갱이 사이에 있는 공기를 들이 마신다. 빗물이 땅에 스며들면 흙 알갱이들 사이의 공간에 물이 찬다. 이렇게 되면 지렁이는 숨을 쉴 수 없어서 꿈틀거리며 땅 위로 올라온다. 땅 위에서야 비로소 지렁이는 숨을 쉴 수 있게 된다.

위의 글을 다 읽었다면 다음 장으로 넘어가도 좋습니다. 필요하다면 한 번 더 읽어도 좋습니다. 하지만, 다음 장으로 넘어간 후에는 다시 이곳으로 돌아올 수 없습니다.

아래 문장들을 주의 깊게 읽으세요. 만약 문장의 내용이 앞에서 읽은 글의 내용에 비추어 볼 때 맞으면 ‘예’에 동그라미를 치고, 틀리면 ‘아니오’에 동그라미를 치세요. 내용을 확인하기 위해 앞장으로 돌아가지 마세요.

- 17. 지렁이는 주로 땅 속에서 산다. (예, 아니오)
- 18. 지렁이는 아가미로 호흡을 한다. (예, 아니오)
- 19. 흙 알갱이 사이사이에는 공기가 저장되어 있다. (예, 아니오)
- 20. 지렁이는 땅 속의 흙 알갱이를 뒤집어서 식물들에게 피해를 준다. (예, 아니오)
- 21. 모든 지렁이들은 크기가 작다. (예, 아니오)
- 22. 지렁이의 피부가 건조해지면 호흡하는데 문제가 생긴다. (예, 아니오)
- 23. 지렁이는 시각과 청각을 갖고 있지 않다. (예, 아니오)
- 24. 비가 온 날 지렁이가 땅 위로 올라오는 것은 피부에 물을 적시기 위해서이다.
(예, 아니오)
- 25. 지렁이는 촉각이 발달해 있다. (예, 아니오)
- 26. 새가 지렁이를 사냥하기 가장 쉬운 날은 맑은 날이다. (예, 아니오)
- 27. 지렁이가 흙 사이를 돌아다닐 때 흙 알갱이들이 이리저리 섞인다. (예, 아니오)
- 28. 지렁이가 많이 사는 땅은 어린 식물들이 자라기에 좋지 않다. (예, 아니오)

모든 문제에 ‘예’ 또는 ‘아니오’로 답을 했다면 다음 장으로 넘어가도 좋습니다. 다음 장으로 넘어간 후에는 다시 이곳으로 돌아올 수 없습니다.

아래 글을 주의 깊게 읽어보세요.

양서류일까, 파충류일까?

사람들은 종종 양서류와 파충류를 혼동한다. 실제로 양서류와 파충류는 아주 비슷해 보이지만 둘 사이를 구분 짓는 차이점이 있다. 양서류와 파충류는 어떤 점에서 차이가 있는지 한 번 살펴보자.

양서류의 삶은 두 단계로 나뉘어진다. 양서류는 태어나서 얼마 동안은 물에서 살며, 자라나며 점차 땅 위에서 생활한다. 개구리와 도롱뇽 같은 양서류들은 대부분 연못이나 개울에서 태어난다. 이들은 어린 시절 물고기처럼 아가미를 가지고 있어서 물 속에서 호흡할 수 있다. 양서류는 자라면서 아가미가 없어지고 폐가 발달하며 땅에서 호흡할 수 있게 된다. 개구리의 새끼인 올챙이는 다리가 없다. 하지만 다 자란 개구리는 다리가 있어서 땅 위를 자유롭게 이동할 수 있다.

거북, 뱀, 악어, 도마뱀은 파충류에 속한다. 대부분의 파충류들은 구멍이나 등지에 알을 낳는다. 양서류와는 달리 파충류의 삶은 두 단계로 나뉘어지지 않는다. 파충류의 새끼는 크기만 작을 뿐 처음부터 어른과 똑같은 모양을 하고 있다. 파충류의 피부는 비늘로 덮여 있다. 비늘은 파충류의 몸이 너무 건조해지는 것을 막아준다.

위의 글을 다 읽었다면 다음 장으로 넘어가도 좋습니다. 필요하다면 한 번 더 읽어도 좋습니다. 하지만, 다음 장으로 넘어간 후에는 다시 이곳으로 돌아올 수 없습니다.

아래 문장들을 주의 깊게 읽으세요. 만약 문장의 내용이 앞에서 읽은 글의 내용에 비추어 볼 때 맞으면 ‘예’에 동그라미를 치고, 틀리면 ‘아니오’에 동그라미를 치세요. 내용을 확인하기 위해 앞장으로 돌아가지 마세요.

- 29. 양서류와 파충류는 알을 낳는 장소가 서로 다르다. (예, 아니오)
- 30. 양서류에 속하는 동물들로는 개구리와 도롱뇽이 있다. (예, 아니오)
- 31. 다 자란 양서류는 폐로 호흡하며 땅 위에서만 생활할 수 있다. (예, 아니오)
- 32. 아가미는 물 속에서 호흡하는데 필요한 신체 기관이다. (예, 아니오)
- 33. 파충류의 피부는 몸이 마르지 않게 해주는 비늘로 덮여있다. (예, 아니오)
- 34. 개구리는 물 속과 땅 위 모두에서 호흡할 수 있다. (예, 아니오)
- 35. 파충류들은 구멍을 파거나 둥지를 만들어 알을 낳는다. (예, 아니오)
- 36. 올챙이도 다리만 있으면 땅 위에서 생활할 수 있다. (예, 아니오)
- 37. 알에서 깨어난 양서류는 곧바로 땅 위로 올라온다. (예, 아니오)
- 38. 어른 도롱뇽은 피부로 호흡한다. (예, 아니오)
- 39. 파충류의 새끼와 어미는 크기와 생김새가 다르다. (예, 아니오)
- 40. 다 자란 양서류는 땅 위에서 주로 생활한다. (예, 아니오)
- 41. 올챙이는 아가미로 호흡하기 때문에 어류에 속한다. (예, 아니오)
- 42. 파충류는 아가미가 없으며 폐로 숨을 쉰다. (예, 아니오)
- 43. 양서류는 어린 시절 물에서 생활하고 어른이 되어서는 땅 위에서도 생활한다.
(예, 아니오)
- 44. 파충류는 어릴 때와 커서 생활하는 곳이 달라진다. (예, 아니오)

모든 문제에 ‘예’ 또는 ‘아니오’로 답을 했다면 다음 장으로 넘어가도 좋습니다. 다음 장으로 넘어간 후에는 다시 이곳으로 돌아올 수 없습니다.

아래 글을 주의 깊게 읽어보세요.

딸꾹질은 왜 생기나?

네가 조용한 교실에서 수업을 받고 있다고 상상해 보자. 그 때 갑자기 딸꾹질이 시작된다. 너는 딸꾹질을 멈추려고 숨을 참아보지만 딸꾹질은 계속 된다.

이런 일은 일상에서 자주 일어나지만 과학자들은 왜 딸꾹질이 생기는 지 모른다. 너무 많이 먹거나, 너무 빨리 마실 때 딸꾹질이 생길 수 있다. 하지만 특별한 이유도 없이 딸꾹질이 생기기도 한다.

무엇 때문에 이러한 불쾌한 소리가 생기는 걸까? 모든 딸꾹질은 횡경막에서 시작된다. 횡경막은 폐 아래쪽에 있는 큰 근육이다. 횡경막은 우리가 숨을 들이 마시고 내쉴 수 있게 해준다. 횡경막이 아래로 움직일 때 폐 속으로 공기가 들어온다. 횡경막이 위로 움직이면 폐 속에 있던 공기가 빠져나간다.

보통 때 횡경막은 위아래로 부드럽게 움직인다. 그러나 때때로 이 큰 근육이 갑자기 경련¹⁴을 일으키기도 한다. 경련이 일어나면 많은 양의 공기가 한꺼번에 목구멍 안으로 들어온다. 이 때 목구멍을 지나던 공기가 성대를 치게 되면 ‘딸꾹’ 소리가 난다.

대부분의 딸꾹질은 금방 없어진다. 하지만 아주 드물게 여러 날, 심하면 여러 주 동안 계속 되기도 한다. 기네스북에는 69년 동안 딸꾹질을 한 것이 최고의 기록으로 남아있다.

아마 여러 가지 딸꾹질 치료법을 들어봤을 것이다. 숨을 참는 방법은 이미 구식이 되었을 수도 있을 만큼...

위의 글을 다 읽었다면 다음 장으로 넘어가도 좋습니다. 필요하다면 한 번 더 읽어도 좋습니다. 하지만, 다음 장으로 넘어간 후에는 다시 이곳으로 돌아올 수 없습니다.

¹⁴근육이 갑자기 움츠려 들거나 떨게 되는 현상

아래 문장들을 주의 깊게 읽으세요. 만약 문장의 내용이 앞에서 읽은 글의 내용에 비추어 볼 때 맞으면 ‘예’에 동그라미를 치고, 틀리면 ‘아니오’에 동그라미를 치세요. 내용을 확인하기 위해 앞장으로 돌아가지 마세요.

- 45. 숨을 참아도 딸꾹질은 멈추지 않는 경우가 많이 있다. (예, 아니오)
- 46. 우리가 들숨과 날숨을 할 수 있는 것은 횡경막이 있기 때문이다. (예, 아니오)
- 47. 딸꾹질을 완전하게 멈추는 방법이 발견되었다. (예, 아니오)
- 48. 대부분의 딸꾹질은 오래 지속되지만 가끔씩 금방 멎기도 한다. (예, 아니오)
- 49. 딸꾹질을 하고 싶을 땐 언제든지 시작할 수 있다. (예, 아니오)
- 50. 딸꾹질을 멈추게 하려면 횡경막에 일어난 경련을 진정시켜야 한다. (예, 아니오)
- 51. 딸꾹질이 시작되고 난 후 횡경막에 경련이 일어난다. (예, 아니오)
- 52. 딸꾹질을 치료하는 다양한 방법들이 시도되었다. (예, 아니오)
- 53. 횡경막은 아래 위로 움직이며 폐 속으로 공기가 드나들어 숨쉴 수 있게 도와준다.
(예, 아니오)
- 54. 횡경막에 경련이 없을 때에도 딸꾹질이 생기기도 한다. (예, 아니오)
- 55. 과학자들도 딸꾹질의 원인을 잘 모른다. (예, 아니오)
- 56. 딸꾹질이 시작되면 폐 속에 공기가 들어오지 못하게 된다. (예, 아니오)

문제를 푸느라 수고했습니다!

다음 장으로 넘어가면 요약하기 문제가 나옵니다. 다음 장으로 넘어간 후에는 이곳으로 다시 돌아올 수 없습니다.

아래의 글을 다시 한 번 주의 깊게 읽어보세요. 다 읽었으면 뒷면에 글의 내용을 요약해 보세요. 요약하기란 중요한 내용들을 찾아내어 짜임새 있게 정리하는 것을 말합니다.

양서류일까, 파충류일까?

사람들은 종종 양서류와 파충류를 혼동한다. 실제로 양서류와 파충류는 아주 비슷해 보이지만 둘 사이를 구분 짓는 차이점이 있다. 양서류와 파충류는 어떤 점에서 차이가 있는지 한 번 살펴보자.

양서류의 삶은 두 단계로 나누어진다. 양서류는 태어나서 얼마 동안은 물에서 살며, 자라나며 점차 땅 위에서 생활한다. 개구리와 도롱뇽 같은 양서류들은 대부분 연못이나 개울에서 태어난다. 이들은 어린 시절 물고기처럼 아가미를 가지고 있어서 물 속에서 호흡할 수 있다. 양서류는 자라면서 아가미가 없어지고 폐가 발달하며 땅에서 호흡할 수 있게 된다. 개구리의 새끼인 올챙이는 다리가 없다. 하지만 다 자란 개구리는 다리가 있어서 땅 위를 자유롭게 이동할 수 있다.

거북, 뱀, 악어, 도마뱀은 파충류에 속한다. 대부분의 파충류들은 구멍이나 등지에 알을 낳는다. 양서류와는 달리 파충류의 삶은 두 단계로 나누어지지 않는다. 파충류의 새끼는 크기만 작을 뿐 처음부터 어른과 똑같은 모양을 하고 있다. 파충류의 피부는 비늘로 덮여 있다. 비늘은 파충류의 몸이 너무 건조해지는 것을 막아준다.

앞에서 읽은 글 ‘양서류일까, 파충류일까?’를 요약해 보세요. 요약하기란 중요한 내용들을 찾아서 짜임새 있게 정리하는 것을 말합니다. 단, 앞에 나온 글을 보기 위해 절대로 앞장으로 돌아가지 마세요.

Appendix L

English Test Materials for Reading Comprehension and Written Summarization

Pretest Materials

This test intends to assess your understanding of four passages. One of the four passages will be presented at a time. You need to read each passage carefully and, then, answer questions that follow the passage. Here is the first passage. Please read it carefully.

Do other animals sweat?

Dogs have sweat glands, but they can't sweat. To keep cool, a dog lets its tongue hang out of its mouth and breathes quickly. As the dog pants, water evaporates from the its mouth and carries away heat. Elephants have no sweat glands. They get rid of extra heat by flapping their huge ears or spraying water on themselves with their long trunks. A hippopotamus has special glands in its skin that give off a pink, oily liquid. That liquid helps keep the hippo's skin from drying out.

Why do people often take a shower after exercising? They want to wash off all that extra sweat, but there's also another reason. When sweat first forms on the skin, it has no odor. But as it is broken down by bacteria, it can start to smell really bad. However, sweat glands do not become active until a person is around 10 or 12 years old. As a result, babies and young children do not smell bad when they sweat.

When you finish reading the passage above, you may turn to the next page. You may read the passage once again, if necessary. However, when you turn to the next page, you **must not return to** here.

Read the following sentences carefully. You may circle *yes* if the sentences mean the same things as the sentences in the original passage and *no* if the sentences have different meanings than the sentences in the passage. You **must not look back at** the previous page.

1. People produce more odor during summer than winter. (Yes, No)
2. Elephants use water and wind to reduce their body temperature. (Yes, No)
3. Some animals without sweat glands sometimes sweat. (Yes, No)
4. Sweat emits a bad smell as soon as you sweat. (Yes, No)
5. Sweat will not smell unless bacteria multiply. (Yes, No)
6. Children before the ages of 10-12 sweat a lot. (Yes, No)
7. People who perspire less smell less than those who do more. (Yes, No)
8. Dogs let heat out of their mouth as they pant. (Yes, No)
9. If you take a shower after exercising, bacteria are activated. (Yes, No)
10. All animals with sweat glands sweat. (Yes, No)
11. Children sweat less than adults. (Yes, No)
12. Elephants sweat under their ears. (Yes, No)
13. Dogs lower their body temperature hanging out their tongue. (Yes, No)
14. Elephants do not have an organ that secretes sweat. (Yes, No)
15. Dogs frequently pant in winter. (Yes, No)
16. Odor is emitted because bacteria decompose sweat. (Yes, No)

You may turn to the next page if you circled *yes* or *no* to all sentences. After you turn the page, you **must not return to** this page.

Please read the following passage carefully.

Ocean dwellers disappearing

Today two of the world's biggest sea animals are disappearing: there are fewer great white sharks and blue whales than ever before. People have killed too many of them. People have killed what these creatures eat for food. And ocean pollution has hurt their homes.

The great white shark lives in the warm parts of oceans all over the world. This huge fish eats large fish, dolphins, sea turtles, and seals. They will also attack people. This makes people very afraid of them. The great white shark does something very unusual for a fish. It gives birth to live babies. But it cannot make any milk for its babies. The babies must start to eat other animals right away.

The blue whale is the largest animal on Earth. If a land animal got as big, it would not be able to move! Blue whales can be huge because the water holds up their weight. A blue whale can live to be 100 years old. This mammal is found in oceans all over the world. Like the great white shark, it eats other animals. But what this giant eats is krill! Krill are very tiny animals that look like shrimp. Unlike the great white shark, the blue whale never attacks humans. But humans have killed many of them for their body fat (blubber), oil, and meat.

Both the great white shark and the blue whale are endangered ocean animals. No one wants these interesting sea creatures to completely disappear. That is why people are working to save them.

When you finish reading the passage above, you may turn to the next page. You may read the passage once again, if necessary. However, when you turn to the next page, you **must not return to** here.

Read the following sentences carefully. You may circle *yes* if the sentences mean the same things as the sentences in the original passage and *no* if the sentences have different meanings than the sentences in the passage. You **must not look back at** the previous page.

17. Humans are the most dangerous foe to great white sharks and blue whales. (Yes, No)

18. Some kinds of fish feed their babies milk. (Yes, No)

19. Great white sharks are found in every ocean all over the world, but blue whales are not.

(Yes, No)

20. Great white sharks eat large sea animals. (Yes, No)

21. Blue whales' fat and meat have been used by humans. (Yes, No)

22. Great white sharks are frequently observed in the Arctic and Antarctic oceans. (Yes, No)

23. The blue whale is biggest of all animals that live in the Earth. (Yes, No)

24. Great white sharks lay eggs like other fish and their babies hatch from eggs. (Yes, No)

25. Due to ocean pollution, the habitats of great white sharks and blue whales have become smaller. (Yes, No)

26. Most blue whales live in warm oceans. (Yes, No)

27. Blue whales have to eat large amounts of krill to survive. (Yes, No)

28. Baby great white sharks eat milk until they grow enough to eat fish. (Yes, No)

You may turn to the next page if you circled *yes* or *no* to all sentences. After you turn the page, you **must not return to** this page.

Please read the following passage carefully.

Gravity: The invisible force

What goes up must come down. But why? The invisible force that pulls things toward the ground is gravity. Isaac Newton named this force after he watched an apple fall from a tree. He noticed that things always fell down. They never “fell up.”

Later, he figured out the important role that gravity plays on Earth. The moon’s gravity pulling on the water makes the tides change in the oceans. Gravity keeps the Earth’s atmosphere from flying off into space. The atmosphere is what gives us weather. Without it, Earth would have no weather at all! Gravity also keeps us from flying off into space. It also keeps the Earth and all of the other planets going around the sun. And it keeps the moon going around the Earth. Of course, the Earth never touches the moon. But it doesn’t have to. Gravity is something that you can’t see or touch.

The farther out in space you go, the less gravity there is. When people leave the space shuttle, they have to stay on lines hooked to it. If they didn’t, they would just float away! But all things use gravity to pull other things towards them. Usually, the bigger something is, the stronger its gravity. Jupiter is very, very big. It is so big that all of the other planets could fit inside of it! So it has stronger gravity than all of the other planets. But Earth is big, too. It has enough gravity to pull space rocks to it when they pass close by. It’s lucky for us that most of them burn up in our atmosphere. Otherwise, we could be in big trouble!

When you finish reading the passage above, you may turn to the next page. You may read the passage once again, if necessary. However, when you turn to the next page, you **must not return to** here.

Read the following sentences carefully. You may circle *yes* if the sentences mean the same things as the sentences in the original passage and *no* if the sentences have different meanings than the sentences in the passage. You **must not look back at** the previous page.

- 29. There will be no weather without gravity on Earth. (Yes, No)
- 30. The Earth has the strongest gravity among the planets in the solar system. (Yes, No)
- 31. There is gravity between the sun and planets revolving around the sun. (Yes, No)
- 32. Space rocks near the Earth strongly pull it. (Yes, No)
- 33. Bigger objects have more powerful gravity in comparison to smaller ones. (Yes, No)
- 34. The moon is not pulled to the Earth because it is as big as the Earth. (Yes, No)
- 35. The Jupiter is biggest of the planets in the solar system. (Yes, No)
- 36. The air on Earth is not affected by gravity. (Yes, No)
- 37. An apple falls down because the Earth's gravity is larger than the apple's gravity. (Yes, No)
- 38. People can float in the air without gravity on Earth. (Yes, No)
- 39. In order to float in the air, force stronger than gravity is needed. (Yes, No)
- 40. There is no gravity between humans. (Yes, No)
- 41. Gravity is an invisible power that pulls objects together. (Yes, No)
- 42. Ebb will occur in the ocean when the moon comes near the Earth. (Yes, No)
- 43. If a person flies far away into space, the gravity of the Earth will decrease. (Yes, No)
- 44. There is no weather in the other planets except the Earth because their gravity is weak.
(Yes, No)

You may turn to the next page if you circled *yes* or *no* to every test sentence. After you turn the page, you **must not return** to this page.

Please read the following passage carefully.

Animal communication

When we think of strong animal smells, the first one that comes to mind is probably the skunk's odor. All mammals have special glands that make chemicals. The skunk sprays scent from glands near its tail. This scent allows the skunk to defend itself against bigger animals. Once it has been sprayed, a dog or wolf will usually avoid a skunk. The skunk's spray smells terrible. It can make other animals sick. When a skunk sees an enemy, it acts like it is going to spray. It turns around and holds its tail high. In fact, the skunk would rather not spray. The enemy doesn't know this, though.

Most mammals use scent to mark their territory. They leave the scent on the ground and trees. A female bear uses scent to mark a territory of 3.2 to 9.7 square kilometers. A male bear's territory is much larger. A bear knows it is entering another bear's territory because of the scent.

For a long time, people have known that male deer rub their heads against tree trunks. We once thought this was to knock off old antlers so new ones could grow. In fact, the deer is marking its territory. When it rubs its head, chemicals come out from glands. The scent stays on the ground and trees.

When you finish reading the passage above, you may turn to the next page. You may read the passage once again, if necessary. However, when you turn to the next page, you **must not return to** here.

Read the following sentences carefully. You may circle *yes* if the sentences mean the same things as the sentences in the original passage and *no* if the sentences have different meanings than the sentences in the passage. You **must not look back at** the previous page.

- 45. Skunks suddenly shoot out secretion before the predator notices. (Yes, No)
- 46. Bears own large territories, so they often lose track of their territories. (Yes, No)
- 47. Once skunks raise their tails up, their predators think that it will shoot out its secretion to them. (Yes, No)
- 48. Male deer's secretions, which smell unique, remain in the ground. (Yes, No)
- 49. Female bears live in broader areas than male bear in order to raise their cubs. (Yes, No)
- 50. Every mammal produces chemicals in particular glands. (Yes, No)
- 51. Skunks send secretions out whenever they face predators. (Yes, No)
- 52. Animals' secretions are used to protect themselves from predators and to mark their territories. (Yes, No)
- 53. Male deer rub their heads to attract female deer. (Yes, No)
- 54. Small animals produce an odor to defend themselves from larger animals. (Yes, No)
- 55. A skunk has glands near its tail, in which an odor is sprayed. (Yes, No)
- 56. The same kinds of animals produce similar smells. (Yes, No)

Thank you for your effort.

There is a summarization task in the next page. You **must not return** to this page after you turn the page.

Please read the following passage carefully. After you read it, you are supposed to write a summary of the passage.

Ocean dwellers disappearing

Today two of the world's biggest sea animals are disappearing: there are fewer great white sharks and blue whales than ever before. People have killed too many of them. People have killed what these creatures eat for food. And ocean pollution has hurt their homes.

The great white shark lives in the warm parts of oceans all over the world. This huge fish eats large fish, dolphins, sea turtles, and seals. They will also attack people. This makes people very afraid of them. The great white shark does something very unusual for a fish. It gives birth to live babies. But it cannot make any milk for its babies. The babies must start to eat other animals right away.

The blue whale is the largest animal on Earth. If a land animal got as big, it would not be able to move! Blue whales can be huge because the water holds up their weight. A blue whale can live to be 100 years old. This mammal is found in oceans all over the world. Like the great white shark, it eats other animals. But what this giant eats is krill! Krill are very tiny animals that look like shrimp. Unlike the great white shark, the blue whale never attacks humans. But humans have killed many of them for their body fat (blubber), oil, and meat.

Both the great white shark and the blue whale are endangered ocean animals. No one wants these interesting sea creatures to completely disappear. That is why people are working to save them.

When you finish reading the passage above, you may turn to the next page. You may read the passage once again, if necessary. However, when you turn to the next page, you **must not return to** here.

Summarize the passage, “Ocean dwellers disappearing”. Summarization is to identify important information and organize it in a logical order. You **must not look back at** the previous page.

Posttest Materials

This test intends to assess your understanding of four passages. One of the four passages will be presented at a time. You need to read each passage carefully and, then, answer questions that follow the passage. Here is the first passage. Please read it carefully.

Tap into sap

Sap is a mixture of water, sugar, and minerals. It moves along tubes in a plant's stem or trunk from the roots to the leaves. Some plants make a special sap that helps them heal if they are cut. The sap of many plants is sweet. Both people and animals like to tap into this sugary sap for a treat.

Sapsuckers are birds that belong to the woodpecker family. After spending winter in the southern United States, they migrate north, looking for spring sap. Sapsuckers drill small round holes called wells into tree trunks with their strong beaks. They use their long tongues to lap the sticky sap. Other birds and insects sneak in and share the sapsuckers' sugary food.

Sugar maple trees in Canada and the United States have a sweet, colorless sap. During the winter, the sap is stored in the trees' roots. In early spring when freezing nights are followed by warm days. The sap begins to flow up from the roots and through the trunk.

Native Americans were the first people to make maple sugar from sap. They ate maple sugar on fruit, vegetables, grains, and even fish.

When you finish reading the passage above, you may turn to the next page. You may read the passage once again, if necessary. However, when you turn to the next page, you **must not return to** here.

Read the following sentences carefully. You may circle *yes* if the sentences mean the same things as the sentences in the original passage and *no* if the sentences have different meanings than the sentences in the passage. You **must not look back at** the previous page.

1. Sapsuckers plug the hole that they drilled to prevent other birds and insects from approaching it. (Yes, No)
2. Many sugar maple trees grow in the northern area of United States. (Yes, No)
3. The stem of a plant stores nutriments. (Yes, No)
4. Sapsuckers make a hole using their beaks and lick up the sap using their tongues. (Yes, No)
5. The sap of sugar maple trees moves from roots to leaves when the temperature stays high at day and night. (Yes, No)
6. The stem of a plant includes a gateway through which water and nutriments move. (Yes, No)
7. The sap of sugar maple trees is mostly produced on December and January. (Yes, No)
8. Humans and various animals like to eat the sweet sap made in trees. (Yes, No)
9. The Native Americans made a drug from the sap of sugar maple trees. (Yes, No)
10. The Native Americans were the first people to use the sap of sugar maple trees. (Yes, No)
11. There is much difference in the temperature between day and night in Canada and the northern United States in winter. (Yes, No)
12. A cut plant loses a lot of sap from the cut, so it begins to weaken. (Yes, No)
13. Roots and leaves are connected through a tube. (Yes, No)
14. The Native Americans ate the sap of sugar maple trees on foods. (Yes, No)
15. The sap of sugar maple trees will remain in the roots if the temperature does not differ to a great extent between day and night. (Yes, No)
16. Sapsuckers are a resident bird that lives in the northern United States where a lot of sugar maple trees grow. (Yes, No)

You may turn to the next page if you circled *yes* or *no* to every test sentence. After you turn the page, you **must not return** to this page.

Please read the following passage carefully.

Boa constrictor

The boa constrictor is a kind of snake. Snakes, like lizards and turtles, are a kind of reptile. Unlike lizards and turtles, snakes have no arms and no legs. Snakes move using their muscles to curl up and then spread out.

Like all reptiles, boa constrictors are cold blooded. This means they need to live in a warm place. Most boa constrictors live in the rain forests of Central and South America.

Boa constrictors are light brown and pink. These colors help them blend in and be nearly invisible in the rain forest.

Boa constrictors are predators, or hunters. Boa constrictors eat meat. Young boa constrictors eat small mice. Adult boa constrictors can eat mice or bigger animals. They can even eat something as big as a monkey or a pig.

The boa constrictor gets food by first catching it and then squeezing it until it can't breathe. Then it eats the food whole.

When you finish reading the passage above, you may turn to the next page. You may read the passage once again, if necessary. However, when you turn to the next page, you **must not return to** here.

Read the following sentences carefully. You may circle *yes* if the sentences mean the same things as the sentences in the original passage and *no* if the sentences have different meanings than the sentences in the passage. You **must not look back at** the previous page.

17. Snakes, lizards, and turtles become inactive as the temperature turns low. (Yes, No)
18. A boa constrictor feeds on other animals. (Yes, No)
19. The body colors of a boa constrictor stand out in the rainforest. (Yes, No)
20. A boa constrictor kills its prey using a strong poison. (Yes, No)
21. A grown-up boa constrictor does not eat mice any longer. (Yes, No)
22. Turtles, lizards, and snakes are a kind of reptile. (Yes, No)
23. Lizards and turtles use more muscles than snakes to move. (Yes, No)
24. Protective colors of animals are mostly similar to the colors of natural environments where they live. (Yes, No)
25. The body temperature of a boa constrictor stays constant and is not affected by the environmental temperature. (Yes, No)
26. There are many kinds of reptiles living in the rainforest. (Yes, No)
27. Snakes move wriggling their bodies. (Yes, No)
28. Boa constrictors live in hot and cold areas. (Yes, No)

You may turn to the next page if you circled *yes* or *no* to all sentences. After you turn the page, you **must not return to** this page.

Please read the following passage carefully.

Your genes

Do you have curly hair? Are you taller than other kids your age? These characteristics were decided before you were born. You got your traits from your parents. They passed their traits on to you through genes.

Genes carry codes for blue eyes or brown eyes. Genes say how tall you will get and what color hair you will have. You got half of your genes from your mother. You got half of your genes from your father. So you have your own set of genes. Each person gets different genes for each body part. That is why you look like-but not exactly like-your brother or sister.

A dominant gene shows up most of the time. Brown eyes are dominant over blue eyes. A recessive gene shows up less often. Light hair comes from a recessive gene. Dark hair is more common. Look at the eye color and hair color of the people around you. You will see that this is true.

Genes help to make you who you are. But they don't tell the whole story. Your genes may help you to be fast and strong. But you still need to learn how to run or swim or skate well.

When you finish reading the passage above, you may turn to the next page. You may read the passage once again, if necessary. However, when you turn to the next page, you **must not return to** here.

Read the following sentences carefully. You may circle *yes* if the sentences mean the same things as the sentences in the original passage and *no* if the sentences have different meanings than the sentences in the passage. You **must not look back at** the previous page.

- 29. Genes contain information about eye color, hair color, appearance, and height. (Yes, No)
- 30. Genetic testing reveals the parent-child relationship. (Yes, No)
- 31. The gene for double eyelid is dominant. (Yes, No)
- 32. All the features that a person has are determined by genes. (Yes, No)
- 33. The height of identical twins will be similar. (Yes, No)
- 34. There are more people who have dark hair than those who have light-colored hair. (Yes, No)
- 35. Many of your physical characteristics have nothing to do with the information contained in your genes. (Yes, No)
- 36. There are more people with blue eyes than those with brown eyes. (Yes, No)
- 37. Dominant genes more often appear than recessive genes. (Yes, No)
- 38. The grandparents' genes do not affect their grandchildren. (Yes, No)
- 39. The genes for blue eyes and dark hair are dominant against those for brown eyes and light-colored hair. (Yes, No)
- 40. Curly hair is a dominant gene for Koreans. (Yes, No)
- 41. Parents' characteristics are passed down to the next generation through genes. (Yes, No)
- 42. Siblings do not always have the same genes. (Yes, No)
- 43. The analysis of genetic information can reveal whether you will swim and skate well.
(Yes, No)
- 44. The study of parents' genes can reveal their children's hair shape and eye color in advance.
(Yes, No)

You may turn to the next page if you circled *yes* or *no* to every test sentence. After you turn the page, you **must not return** to this page.

Please read the following passage carefully.

Making energy from the moon

Tides are the regular rise and fall of the water in the seas. You can see the difference between high and low tides at an ocean dock. At high tide, you cannot see the posts that hold up the dock. At low tide, you may be able to see them. What causes this big change in the level of the water? The moon!

As the moon goes around the Earth, its gravity pulls on the water. This pull makes the water move. This movement is called the tide. Long ago, people believed that the Earth was alive. They thought that the Earth's breathing caused the tides! Other people saw that the high and low tides followed the crossing of the moon overhead. But it wasn't until 1687 that people figured out just how the moon caused the tides.

It takes the moon one day to go around the Earth once – so tides rise and fall twice each day. Because people know how the moon moves, they can tell when the tide will be high or low. Tides are so constant that France built a power plant that uses the rise and fall of the tides to make electric power. When the tide is high, a gate opens. Water rushed into a space. Then the gate is closed. At low tide, another gate opens. The stored water flows down to a turbine. The turbine spins and makes electricity. This is a good way to make power. But power plants that use tides can be built only in a few places.

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Read the following sentences carefully. You may circle *yes* if the sentences mean the same things as the sentences in the original passage and *no* if the sentences have different meanings than the sentences in the passage. You **must not look back at** the previous page.

- 45. The closer the moon is to the Earth, the stronger it will pull the ocean water. (Yes, No)
- 46. Tides are caused because the moon revolves around the sun. (Yes, No)
- 47. The level of ocean water differs during flow and ebb. (Yes, No)
- 48. There is no ebb occurring in the beaches where flow happens. (Yes, No)
- 49. Somebody thought that tides occur because the Earth inhales and exhales. (Yes, No)
- 50. If there is the ocean in the moon, there should be flow and ebb in the moon. (Yes, No)
- 51. In many places, electricity is produced using the difference between high and low tides.
(Yes, No)
- 52. There is a large gap between high and low tides in the beaches of France. (Yes, No)
- 53. The occurrence of flow and ebb is irregular, so it is difficult to predict when either one
happens. (Yes, No)
- 54. There should be ebb occurring in the ocean near the moon. (Yes, No)
- 55. Tides are a phenomenon that flow and ebb repeatedly occur in turns. (Yes, No)
- 56. Farmers must be more aware of the movement of the moon than fishermen. (Yes, No)

Thank you for your effort.

There is a summarization task in the next page. You **must not return** to this page after you turn the page.

Please read the following passage carefully. After you read it, you are supposed to write a summary of the passage.

Boa constrictor

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Like all reptiles, boa constrictors are cold blooded. This means they need to live in a warm place. Most boa constrictors live in the rain forests of Central and South America.

Boa constrictors are light brown and pink. These colors help them blend in and be nearly invisible in the rain forest.

Boa constrictors are predators, or hunters. Boa constrictors eat meat. Young boa constrictors eat small mice. Adult boa constrictors can eat mice or bigger animals. They can even eat something as big as a monkey or a pig.

The boa constrictor gets food by first catching it and then squeezing it until it can't breathe. Then it eats the food whole.

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Summarize the passage, “Boa constrictor”. Summarization is to identify important information and organize it in a logical order. You **must not look back at** the previous page.

Followup Test Materials

This test intends to assess your understanding of four passages. One of the four passages will be presented at a time. You need to read each passage carefully and, then, answer questions that follow the passage. Here is the first passage. Please read it carefully.

Why do we dream some nights and not other nights?

No one knows all about dreams. But I can tell you a little.

Everyone seems to have dreams. Most of use spend 1 ½ to 2 hours dreaming every night.

How do we know that? Mostly by studying people during sleep. When the brain is active, there are small electrical currents that can be detected even on the surface of your head. Scientists call this pattern of electrical activity an electroencephalogram.

Another thing that can happen during sleep is a movement of the eyes, called REM for rapid eye movement. It was found that the three things-dreaming, one special kind of electrical activity, and REM-all go together. During these periods of “REM sleep,” you can tell that a person is dreaming without ever waking the person up.

Scientists think that almost all mammals and birds have dreams because they have periods of brain electrical activity that match REM sleep in humans.

Finally, unless we happen to wake up during a dreaming period, we do not remember our dreams. So when you wake up feeling that you did not have any dreams, you probably slept through them.

When you finish reading the passage above, you may turn to the next page. You may read the passage once again, if necessary. However, when you turn to the next page, you **must not return to** here.

Read the following sentences carefully. You may circle *yes* if the sentences mean the same things as the sentences in the original passage and *no* if the sentences have different meanings than the sentences in the passage. You **must not look back at** the previous page.

1. The brain is inactive during sleep. (Yes, No)
2. The rapid eye movement occurs whenever you dream. (Yes, No)
3. Not many people have a dream every day. (Yes, No)
4. Cats and dogs also have rapid eye movement during sleep. (Yes, No)
5. Most of the information about dreams has been found until recently. (Yes, No)
6. Precise devices are needed to detect electrical activities occurring in the brain. (Yes, No)
7. Electrical activities occur in the brain of mammals and birds during sleep. (Yes, No)
8. Electroencephalogram is detected during sleep. (Yes, No)
9. Failure to remember dreams is not because there is memory problem. (Yes, No)
10. The fact that eyes move fast during sleep indicates that the person is awakening. (Yes, No)
11. Pigeons do not have rapid eye movement because they do not sleep. (Yes, No)
12. When people wake up following rapid eye movement, they feel that they did not dream.
(Yes, No)
13. The study of dreams still continues. (Yes, No)
14. People always wake up after rapid eye movement has passed. (Yes, No)
15. The study of dreams is conducted by investigating humans. (Yes, No)
16. The brain generates strong electricity while we are dreaming. (Yes, No)

You may turn to the next page if you circled *yes* or *no* to all sentences. After you turn the page, you **must not return** to this page.

Please read the following passage carefully.

Wiggling worms

They live below the ground. Birds think they taste good. What are they? Earthworms! Most earthworms look like thick brown string. Earthworms come in many sizes. They might be less than an inch, or 2.5 centimeters, long. They might be longer than 10 feet, or 3 meters. Earthworms cannot see or hear. How do they get around? They feel their way.

Wiggling earthworms move dirt around. This mixes the soil up. Plants grow well in this mixed-up soil.

It has just rained. Earthworms seem to be everywhere. Why? Earthworms breathe through their skin. They take in air trapped between pieces of dirt. Rain soaks into the ground and fills the air spaces. The worms cannot breathe, so they wiggle above ground. There they can catch their breath.

When you finish reading the passage above, you may turn to the next page. You may read the passage once again, if necessary. However, when you turn to the next page, you **must not return to** here.

Read the following sentences carefully. You may circle *yes* if the sentences mean the same things as the sentences in the original passage and *no* if the sentences have different meanings than the sentences in the passage. You **must not look back at** the previous page.

17. Earthworms usually live in the ground. (Yes, No)
18. Earthworms breathe through gills. (Yes, No)
19. The air is stored between pieces of soil. ((Yes, No)
20. Earthworms damage plants by digging through soil. (Yes, No)
21. All earthworms are small. (Yes, No)
22. If earthworm's skin gets dry, it will have problems with breathing. (Yes, No)
23. Earthworms do not have visual and auditory senses. (Yes, No)
24. Earthworms come out of the ground to soak their skin in water on rainy days. (Yes, No)
25. Earthworms have a highly developed sense of touch. (Yes, No)
26. Birds can catch earthworms best on sunny days. (Yes, No)
27. When earthworms move around in the earth, soil grains are mixed up. (Yes, No)
28. Young plants do not grow well in the land where many earthworms live. (Yes, No)

You may turn to the next page if you circled *yes* or *no* to every test sentence. After you turn the page, you **must not return** to this page.

Please read the following passage carefully.

Amphibians or reptiles?

People often get amphibians and reptiles mixed up. After all, they can look a lot alike. But don't let that trick you. Amphibians and reptiles have some big differences. Let's take a look at what they are.

Amphibians live a double life. They usually spend part of their lives in water and part on land. Many amphibians, such as most frogs and salamanders, begin their lives in ponds or streams. Like fish, they have gills. Young frogs even lack legs. As amphibians grow, they develop lungs for breathing on land.

Turtles, snakes, crocodiles, and lizards are all reptiles. Most reptiles lay eggs in holes or nests. Unlike most amphibians, reptiles don't go through two stages of life. From the start, reptile babies look like adults, only smaller. Reptiles have scaly skin. The scales keep their bodies from getting too dry.

When you finish reading the passage above, you may turn to the next page. You may read the passage once again, if necessary. However, when you turn to the next page, you **must not return to** here.

Read the following sentences carefully. You may circle *yes* if the sentences mean the same things as the sentences in the original passage and *no* if the sentences have different meanings than the sentences in the passage. You **must not look back at** the previous page.

- 29. Amphibians and reptiles lay eggs in different places. (Yes, No)
- 30. Frogs and salamanders belong to the amphibian family. (Yes, No)
- 31. Adult amphibians breathe through lungs and live only on land. (Yes, No)
- 32. Gills are an organ that is needed to breathe under water. (Yes, No)
- 33. Reptiles are covered with scales, which prevent their bodies from becoming dry. (Yes, No)
- 34. Frogs can breathe in water and on land. (Yes, No)
- 35. Reptiles dig holes or make nests where they lay eggs. (Yes, No)
- 36. Tadpoles could live on land if they had legs. (Yes, No)
- 37. Amphibians that hatch out of eggs immediately move onto land. (Yes, No)
- 38. Adult salamanders breathe through their skin. (Yes, No)
- 39. Baby reptiles are different from adult reptiles in size and look. (Yes, No)
- 40. Grown-up amphibians mostly live on land. (Yes, No)
- 41. Tadpoles belong to the fish family since they breathe through gills. (Yes, No)
- 42. Reptiles do not have gills, so they breathe through lungs. (Yes, No)
- 43. Young amphibians live in water and adult amphibians can live on land and in water.
(Yes, No)
- 44. Baby and adult reptiles live in different areas. (Yes, No)

You may turn to the next page if you circled *yes* or *no* to every test sentence. After you turn the page, you **must not return** to this page.

Please read the following passage carefully.

What causes the hiccups?

You are sitting quietly in class. Suddenly a loud “hic” bursts from your mouth. You hold your breath but the hiccups keep coming.

They are a common problem, but scientists really don’t know why we get the hiccups. Sometimes they start when we eat too much or drink too fast. Other times they seem to appear for no good reason.

So what causes these annoying little sounds? It all starts with the diaphragm. The diaphragm is a large muscle under the lungs in your chest. It lets you breathe in and out. When the diaphragm moves down, your lungs fill with air. When your diaphragm moves up your lungs push air out.

Usually the diaphragm works smoothly in an up-and-down motion. But sometimes this big muscle can suddenly twitch. This causes you to take in a large gulp of air. When the air hits the vocal chords in your throat, the hiccup sound is made.

Most hiccups go away in a short period of time. But in some rare cases, they can go on for days or even weeks. The *Guinness Book of Records* says the longest case of hiccups lasted 69 years!

You have probably heard of many cures for the hiccups. In fact, you may be tired of holding your breath...

When you finish reading the passage above, you may turn to the next page. You may read the passage once again, if necessary. However, when you turn to the next page, you **must not return to** here.

Read the following sentences carefully. You may circle *yes* if the sentences mean the same things as the sentences in the original passage and *no* if the sentences have different meanings than the sentences in the passage. You **must not look back at** the previous page.

- 45. Hiccups do not stop sometimes although you hold your breath. (Yes, No)
- 46. Diaphragm controls inhalation and exhalation. (Yes, No)
- 47. The way to completely stop hiccups has been revealed. (Yes, No)
- 48. Most hiccups go on for a long time, but they sometimes stop shortly. (Yes, No)
- 49. You can start hiccups whenever you choose to. (Yes, No)
- 50. Spasms in the diaphragm must be calmed in order to stop hiccups. (Yes, No)
- 51. Spasms occur in the diaphragm after hiccups start. (Yes, No)
- 52. Different ways to cure hiccups have been attempted. (Yes, No)
- 53. Diaphragm helps air run through lungs as it moves up and down. (Yes, No)
- 54. Hiccups often occur even when diaphragm does not have spasms. (Yes, No)
- 55. Scientists do not know the cause of hiccups. (Yes, No)
- 56. When hiccups start, air cannot enter the lungs. (Yes, No)

Thank you for your effort.

There is a summarization task in the next page. You **must not return** to this page after you turn the page.

Please read the following passage carefully. After you read it, you are supposed to write a summary of the passage.

Amphibians or reptiles?

People often get amphibians and reptiles mixed up. After all, they can look a lot alike. But don't let that trick you. Amphibians and reptiles have some big differences. Let's take a look at what they are.

Amphibians live a double life. They usually spend part of their lives in water and part on land. Many amphibians, such as most frogs and salamanders, begin their lives in ponds or streams. Like fish, they have gills. Young frogs even lack legs. As amphibians grow, they develop lungs for breathing on land.

Turtles, snakes, crocodiles, and lizards are all reptiles. Most reptiles lay eggs in holes or nests. Unlike most amphibians, reptiles don't go through two stages of life. From the start, reptile babies look like adults, only smaller. Reptiles have scaly skin. The scales keep their bodies from getting too dry.

When you finish reading the passage above, you may turn to the next page. You may read the passage once again, if necessary. However, when you turn to the next page, you **must not return to** here.

Summarize the passage, “Amphibians or reptiles?” Summarization is to identify important information and organize it in a logical order. You **must not look back at** the previous page.