Academic competence for technical reading in English as a foreign language

Mei-Fen Chen
ACADEMIC COMPETENCE FOR TECHNICAL READING
IN ENGLISH AS A FOREIGN LANGUAGE

A Project
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San Bernardino

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by
Mei-Fen Chen
June 2003
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ABSTRACT

Taiwanese students are usually taught English through the grammar translation method, whereas instruction in specialized vocabulary words, technical reading and writing, and metacognitive strategies is largely ignored. Technical texts written in English are exceptionally difficult for Taiwanese college students to read, particularly when students have only learned to memorize grammar rules. This project offers a strategy-based curriculum designed to increase academic competence in technical reading for Taiwanese students of English as a foreign language.

By using a variety of learning strategies for technical reading, students will be better prepared to comprehend technical writing. Therefore, the purpose of this project is to address the problems stated above and improve English as foreign language learning for the students of Taiwan by applying learning strategies for acquiring specialized vocabulary words, enhancing background knowledge, and increasing metacognitive awareness.
ACKNOWLEDGMENTS

I would like to offer my sincere gratitude to many people who have helped me travel a long road to reach this goal. Many thanks to the following individuals:

To Dr. Lynne Diaz-Rico whose valuable instructions and inspiration on this project helped me with many functional strategies which guided my organization and also provided many stylistic and logical corrections to strengthen the focus of the project; to Dr. Gary A. Negin for his valuable instruction and encouragement; to my dear parents and sisters for their encouragement and concern; and to my friends who are sharing all the wonderful learning and life experiences together.
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CHAPTER ONE

INTRODUCTION

Background of the Project

Taiwan is a small island between mainland China and the Pacific Ocean. Because of overcrowding, many Taiwanese leave their homeland in search of a better future. Knowledge of the English language has proven to be an invaluable asset for achieving success outside their homeland.

In Taiwan, knowledge of English has become important for people of all ages. Yet, after six to ten years of English study, most Taiwanese people—even university English majors, and English teachers with an excellent understanding of grammar—often have trouble speaking English with people from other countries, or with other Taiwanese. This is because English classes in Taiwan do not provide proper training and drills in verbal communication skills.

The Role of English in Taiwan

English, as an international language, allows Taiwanese people to keep abreast of the most up-to-date information available. Taiwanese business is often conducted in English, and most faculty positions of
Taiwanese universities require English proficiency. As a result, many Taiwanese spend large amounts of time and money on English classes, hoping to develop skill in speaking, writing, and listening.

Taiwan students need academic competence in English because the better companies in Taiwan require English. Also, Taiwan business is often conducted in English. Employees who are proficient in English possess a competitive advantage.

**Technical Reading in English as a Foreign Language in Taiwan**

The technical use of English as an international language is equally for Taiwanese. International trade and science are developed and conducted in English. Among the linguistic skills of reading, writing, listening and speaking, reading is the most highly valued in both the domains of education and of employment. Although technical reading in English as a foreign language is of great importance in Taiwan, instruction remains at an elementary level of literacy. According to Yau (1993), students at the graduate level continue to use a "bottom up" method for understanding English text.

Yang, in a 1993 study, concludes that many Taiwanese students have strong faith in the effectiveness of formal
structural studies of the English language. For the students in this study, knowledge of vocabulary, grammar, and translation were viewed as the most important factors in learning English; 55 percent named vocabulary as the key element in learning a foreign language, and 91 percent emphasized memorization as an important factor in language acquisition. On the other hand, the same study showed that 90 percent of the students were open to seeking out new strategies for learning English.

According to Yang’s data, a questionnaire showed that over 70 percent of Taiwan vocational college English teachers surveyed use grammar analysis to help students decipher difficult sentences. However, 70 percent of these same English instructors failed to include technical reading strategies in their definition of a comprehensive English reading education.

This research reveals problems in teaching and learning technical reading in English as a foreign language. These problems are as follows:

Lack of Developing English for Academic Competence. Developing English for academic competence is very important in Taiwan because it is a global language used for scientific and technical communication in a workplace that requires increasing technical skills. That is why
most Taiwanese students go to America to study in order to achieve English skills in technical subjects. Towards this goal, they must prepare with a high level of academic competence in English. If they possess high level of academic competence, they will understand not only all technical terminologies in English but also learn how to translate theories into real practice in the real world.

**Lack of Technical Reading Comprehension.** Taiwanese college students have significant difficulty reading technical texts in English. According to Cheng (1993), students lack technical vocabulary as well as knowledge of rules governing the writing of technical paragraphs. These deficiencies, in turn, negatively affect their technical reading skills. Teaching all aspects of technical reading should be an important part of teaching English to Taiwanese students.

**Lack of Learning Specialized Vocabulary.** Many teachers in Taiwan do not teach specialized English vocabulary. Instead, they simply translate the words from the texts without teaching roots, prefixes and suffixes. Without instruction in word structure and analysis, students learn English through rote memorization. This learning technique often results in forgetting much of what was initially learned.
Lack of Applying Background Knowledge in Learning. Students and teachers of English in Taiwan normally use bottom-up learning techniques, such as vocabulary memorization and grammar analysis. They neglect the possibility of teaching text comprehension from a top-down point of view, which emphasizes the student's background knowledge.

Top-down learning methods allow students to actively apply their knowledge, understanding, culture, and personal interests to construct meaning from technical material, rather than passively receiving the information that is written. The top-down method generates a much more meaningful and authentic learning experience for the student.

Lack of Metacognitive Strategies. Metacognitive strategies are largely ignored by teachers in Taiwan. These strategies may or may not be effective for understanding a particular text, and students will develop their own reading strategies without the knowledge of explicit metacognitive strategies. Taiwanese tend to use dictionaries as their main strategy for solving reading difficulties. Dictionary usage is a good way to find the definition of a word, but is not suitable for solving other types of reading obstacles. Metacognitive strategies
are necessary for solving reading difficulties beyond the meaning of individual words, and for teaching students to monitor and adjust their reading habits.

Due to these problems related to the comprehension of technical reading on the part of Taiwanese students, this project explores effective concepts and theories to address these problems.

**Target Teaching Level**

**English Instruction at the Vocational College Level.**

My target level for teaching in Taiwan is the five-year vocational college, which forms a continuum with junior high school and provides three years of secondary studies in addition to two years of college work. The final two years of the five-year vocational school are similar to the two year community college programs found in the United States. Upon graduation from junior high school, students usually take a high school entrance examination. These examinations are very competitive and many students are denied entrance into academic high schools. The five-year vocational colleges, private high schools, and vocational high schools provide alternative educational choices for students who do not pass the high school entrance examinations.
Why do I Prefer This Level? I was a kindergarten teacher at YuKuan Kindergarten for two years. Although I presently have no English teaching experience, my goal is to develop methods that will help students to learn English more effectively. Vocational junior college students are not under pressure to study for entrance examinations and teachers have more flexibility in curriculum and instruction. For these reasons English classes at this level can be more fun and creative for both students and teachers. I believe this level will provide the greatest opportunity to develop curriculum materials for improving technical reading skills in English as a foreign language. For this reason I am choosing the five-year vocational college as my target level.

The Purpose of the Project

The purpose of this project is to provide a theoretical basis and curriculum for the teaching of technical reading comprehension in English as a foreign language. This will give both students and teachers a framework for implementing strategies that promote students’ technical reading competence.
The Content of the Project

This project includes five chapters, as follows:

Chapter One, the introduction, describes the background and problems of English as-a-foreign-language education in Taiwan, and outlines the basic concepts of this project.

Chapter Two, the review of literature, explores five major concepts: developing English skill for academic competence, technical reading and writing, learning specialized vocabulary, background knowledge and metacognition. Chapter Three: the theoretical framework, integrates the concepts explored in Chapter Two and provides a model to guide the teaching and learning of reading. Chapter Four, the curriculum design, explains how the sample curricular unit (see Appendix A) is consonant with the theoretical framework. Chapter Five proposes the assessment that corresponds to the instructional lesson units introduced in Chapter Four.

The Significance of This Project

This project addresses the current problems involved in learning technical reading in English as a foreign language. In this project, I incorporate the concepts of academic competence, technical reading and writing, learning specialized vocabulary, background knowledge, and
metacognition, with the good of creating a curriculum which will help students achieve academic competence in this area.
CHAPTER TWO

REVIEW OF THE LITERATURE

Developing English for Academic Competence

Introduction

In order to attain English language proficiency, developing English for academic competence is important for Taiwanese students. The rate of Taiwanese students studying abroad is getting higher every year, because the good companies in Taiwan require English. Students desire good English skills to obtain better jobs. Second, because Taiwanese business is often conducted in English, Taiwan is becoming internationalized. Proficiency in English is essential for a competitive advantage. With this in mind, Taiwanese are spending large amounts of time and money on English classes to improve their speaking, writing and listening skills. A student in Taiwan must develop specific skills that will result in successful academic achievement in the classroom and that will allow a smooth transition to vocational use of English.

Saville-Troike introduced the term “academic competence” in 1984 to describe the knowledge and skills necessary for students to succeed at their academic tasks. Shih (1992) identified the central goal of academic
competence as the development of reading and thinking strategies for the purpose of reading academic texts and learning new subject matter.

The teacher is a critical element in effective ESL/EFL learning because the teacher provides comprehensible input to the learner. The teacher and the student must engage in collaborative efforts in order to facilitate understanding (Diaz-Rico & Weed, 1995). By utilizing existing skills in the first language, the student will be able to build upon these skills with the anticipation that second language skills development will be achieved in an academic environment. Academic competence is the end result of concentrated efforts between the student and the teacher to learn English to later succeed cultivation of existing skills and knowledge in technical reading and writing of work or world of higher education may require.

A Model of Academic Competence

Academic competence is based on two factors: first, the skills student brings to the classroom; second, coping skills that support classroom instruction (Adamson, 1993).

Three major student skills contributing to academic competence are as follows: universal pragmatic knowledge, language proficiency, and background knowledge (Adamson,
Additionally, student use coping strategies during instruction, including study strategies and production strategies. Figure 1 summarizes these components (see Adamson, p. 106).

![Diagram showing the relationship between academic tasks and coping strategies]

Source: Adamson, 1993, p. 106

Figure 1. How Student Accomplish Academic Tasks

Component 1: Universal Pragmatic Knowledge. Universal pragmatics consists of basic-level concepts, image schemas, and the cooperative principle. Basic level concepts are ideas formulated at the level used in daily life, at which
things are most spontaneously named and recognized. These concepts are generally organized as mental images of objects and events (image schemas). The cooperative principle is a conversational theory formulated by Grice (1975) stating that there is an accepted way of speaking which is generally acknowledged as standard, and must be followed for a conversation to be reciprocal. Because all humans have similar powers of thought and emotion there is certain knowledge that is universal. This universal knowledge can be used as common ground for acquiring a second language.

Component 2: Language Proficiency. Language proficiency can be generalized as a model for learners with different competencies and various areas of strength and proficiency (Adamson, 1993). Specifically, such areas include the following: first, the acquisition of standard English rather than slang. English learners often hear a number of informal words in daily communication, leading to the belief that these words must be learned and understood to grasp the English language; second, the utilization of formulaic expressions, or words and phrases that perform as units of speech, such as greetings; third, the tolerance of inaccuracies in English language acquisition. Some students believe that their grammatical
knowledge must be nearly perfect to maximize academic achievement. However, inaccuracies should be tolerated in limited degrees in order to encourage speaking and prose; fourth, the use of reading in the ESL classroom as a learning tool (see Technical Reading and Writing later in this chapter); finally, the ability to communicate effectively and appropriately in any situation. Furthermore, it is critical for students to engage in as many situations involving oral communication as possible so that they will improve their academic abilities.

A student's native language has a profound impact on future ESL/EFL instruction in a number of ways. According to Saville-Troike (1984), the transfer of native language forms and syntax into English is critical in the acquisition of the new language. Furthermore, first language proficiency is important to the development of reading achievement in the English language.

Component 3: Background Knowledge. According to Adamson (1993), background knowledge is composed of two areas: knowledge of a specific content area, and scripts for school. The first kind is knowledge of a specific content area. Clarke (1980) argued that lack of skill in the target language could be offset by background knowledge. By the same token, a lack of background
knowledge in a subject such as American history can cause an international student to perform poorly in that subject. Another way background knowledge contributes to academic success is through a collective script, or shared understanding of the school's culture and procedures. Background knowledge is such an important component that it will be treated as a key term in its own right later in this chapter.

**Activities to Improve Academic Competence**

In order to achieve academic competence in an ESL/EFL classroom, instructors must provide a myriad of activities that will enhance student learning and competency. Because students are likely to experience discomfort and struggle in unfamiliar environments, it is the responsibility of the instructor to make them feel comfortable and secure in their new surroundings (Gittinger & Seibert, 2002).

Constructive activities may include the following: Reading activities such as previewing chapter content before actual reading, listening activities such as video lectures, testing activities such as practice tests to obtain feedback before the real exams, speaking activities such as conversation partners, note-taking activities such as divided page note-taking, and writing activities such as focused freewriting (Adamson, 1993).
These activities will enhance student learning and improve academic competence, but teachers must be careful to select activities that will meet the needs of the given group. Some activities may work for some students but may not work for others, so teachers must carefully examine the makeup of their classroom populations to determine the best possible set of teaching and learning activities.

Reading and its Contribution to Academic Competence

The importance of reading as a means of learning any type of subject matter cannot be underestimated, as it is the foundation of academic competence in any subject. Furthermore, ESL/EFL instruction is especially dependent upon reading as a precursor for academic achievement and independent learning. Clarke (1980) has identified the importance of psycholinguistic principles in reading and ESL instruction. Furthermore, it should be noted that in general, reading is basically the same process in any language and that it is transferable from one language to another. Shih (1992) also affirmed that ESL classrooms must concentrate on the development of reading strategies that include the construction of background knowledge, guided reading of a text, and post-reading exercises, including discussion and writing activities, all designed
to promote reading skill enhancement. However, it is critical for students to acquire basic study skills that will promote successful mastery of the English language and academic competence in the classroom.

Principles for Helping English-as-a-Second-Language Students Develop Academic Competence

Adamson (1993) has defined five basic principles upon which academic competence can be developed. These principles include the following: explicit, individualized strategies instruction; the language-through-content course; interactive teaching; experiential teaching; and relevant content material.

Explicit, Individualized Strategies Instruction. Explicit, individualized strategies instruction involves a teaching approach that is based on specific competencies and cultural boundaries. A successful method for one student may not benefit another; therefore, it is critical that teachers accurately measure a student’s existing skills in order to develop an effective teaching strategy to maximize learning opportunities.

The Language-Through-Content Course. The language-through-content course comprises a number of techniques that concentrate on student-teacher communications and interacting with peers in study sessions. Adapting study
skills to complement the difficulty of the material being studied is also critical to the achievement of academic competence. According to Adamson (1993), the utilization of authentic texts will provide students with an in-depth analysis of the material in question in order to obtain a grasp on the basic concepts included in the information. Furthermore, such a study technique exposes students to native speakers once they have mastered the content of the material. Finally, this model contributes to the theory that bilingual education is critical to academic success once the subject content has been clearly understood.

**Interactive Teaching.** Interactive teaching is significant to academic competence because it allows a teacher to interact with students in order to evaluate their levels of understanding of the assigned material. The development of improved student-teacher interaction will identify problem areas that require additional attention and will demonstrate the importance of basic communication skills between teachers and students in order to enhance student learning. Finally, the utilization of interactive teaching in the ESL/EFL classroom will promote further understanding of the material by teachers as well as students, both of whom
study techniques and develop new ideas in a collaborative and mutually beneficial manner (Adamson, 1993).

**Experiential Teaching.** The inclusion of experiential teaching activities in ESL classrooms also contributes to academic competence. Basic experiential exercises provide many benefits for students because they allow the visualization of complex material and facilitate ease in understanding. For example, Adamson (1993) discusses an example in which a teacher physically demonstrated the use of a tape recorder to record lectures so that students would better understand the purpose of using such a tool to facilitate learning. The basic theory behind experiential teaching is that students across all cultures will be able to understand complex material if they can relate it to a visual experience, thereby facilitating academic competence and understanding.

**Relevant Content Material.** The final activity that is designed to improve academic competence is the use of relevant content material in daily coursework. By providing students with an overview of the basic essentials required for mainstream learning, they will gain fundamental proficiencies that will enable academic success in comprehensive studies. Using relevant content material in core required courses will motivate students
to maximize their achievements in their daily studies because they gain an awareness of the importance of the material. Therefore, students will capitalize on these lessons in their specialized studies in order to achieve their academic goals.

**Academic Competence in College**

Siebert (1997) has defined seven basic challenges that will increase student survival in the college environment, one of the most stressful situations that anyone can experience. Each of these challenges propose to enhance student learning and include the following: Making the transition from a teaching atmosphere to a learning atmosphere, dealing with increased freedom, replacing discouragement with optimism, building a vigorous self-esteem, developing empathy for peers and their situations, accepting new thoughts and feelings often contradictory in nature, and learning from new experiences. Each of these factors will be outlined briefly below:

1. Making the transition from a teaching atmosphere to a learning atmosphere: College environments often possess highly educated instructors who are brilliant in their area of expertise but often lack sufficient teaching skills.
Therefore, it is the responsibility of the student to make the often difficult transition to an environment where learning is more significant than teaching.

2. Dealing with increased freedom: College brings a significant amount of freedom that is often very difficult to accept and handle. Therefore, it is critical for students to take responsibility for their new-found freedom and organize their lives in order to maximize academic success.

3. Replacing discouragement with optimism: By recognizing that discouragement is a normal part of daily living, students will realize that optimism encourages self-confidence and positive thoughts towards a potentially brilliant future.

4. Building a vigorous self-esteem: By learning from past mistakes and experiences, students will promote healthy self-confidence and will lead to a positive outlook in new situations and subsequent improvement.

5. Developing empathy for peers and their situations: Students encounter difficult people throughout their academic careers. It is important to recognize the possible root of the
negativity in order to encourage positive reactions to such behaviors.

6. Accepting new thoughts and feelings often contradictory in nature: People in general are composed of a myriad of conflicting thoughts and feelings. As a result, they become emotionally flexible and this allows a student to cope with any situation that comes their way.

7. Learning from new experiences: This can be defined as independent learning, and students who come away from a situation with a potential learning experience are able to confront a similar situation with ease and understanding.

Siebert's challenges for survival will promote healthy behaviors in all students, and those who engage in ESL/EFL instruction may particularly benefit from such activities and encouragement.

Stress is an important part of daily living, and identifying the roots of stress are critical to positive well-being and academic achievement (King, 1997). English learners are particularly vulnerable to stressful events, and King emphasizes the following techniques to cope with stress: Counting to ten, controlling negative thoughts, fantasizing, congratulations for a job well done, ignoring
problems that do not have an immediate solution, and performing self-maintenance. Regular practice of these activities will result in personal growth and will transcend to academic activities.

Gardner (1997) identified a number of basic concepts that will improve opportunities for academic success for new students. These include the identification of the real reasons for attending college, handling new-found freedom, the value of college, and the broader benefits of a college education. For many students, these concepts are not clearly identified at the beginning of the college career. The discovery of the reasons behind college attendance will provide students with clarity and focus that will enable them to identify clear objectives in order to achieve unlimited academic competence in their college careers.

Long and McCarthy (1997) considered the development of strong time management skills as an additional factor in the achievement of academic competence. Identifying priorities, establishing a comprehensive study schedule, and finding ways to eliminate distractions are only a few of the options available for students to fulfill their academic goals. Such activities require a tremendous commitment and constant attention in order to achieve
success, and for the English learner, these factors are especially critical in the achievement of academic competence.

A Model of Academic Competence Using Learner and Academic Survival Strategies

Yeh (2001) explored different strategies that can contribute to academic competence, including metacognition, language learner strategies, and academic reading strategies. However, before students can achieve academic competence in any environment, they must first be skilled in academic survival. Figure 2 illustrates a model for academic competence based on this concept. This model can be used by ESL/EFL teachers and students to better understand strategies for academic success. Learner strategies and academic survival skills are the two major components making up the concept of academic competence.

Learner Strategies. Learner strategies can be used in any discipline for the achievement of academic success, but specific strategies are used in the acquisition of a second language. For this reason, learner strategies are divided into general strategies and second language learner strategies.
### Table 1. A Model of Strategies to Achieve Academic Competence

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Source: Yeh, 2001, p. 76

Figure 2. A Model of Strategies to Achieve Academic Competence

General strategies applied to non-SLA contexts are cognitive, metacognitive, and social affective strategies, but these strategies can also be applied to second language acquisition.

Learner strategies applied to SLA contexts include two subsets: second language use and second language learning. Second language use strategies are used in spontaneous speaking and non-academic situations. They are used to retrieve information from long-term memory, and to demonstrate command of the language.
Second language learning strategies are further divided into reading and non-reading strategies. Because Taiwanese ESL/EFL teachers place major emphasis on reading comprehension, reading strategies should be explicitly taught to students. Non-reading strategies consist of speaking, listening and writing strategies used in an academic situation. Together, these four skills support academic competence.

Academic/Survival Skills. Because of the competitive nature of college, students must possess both cultural and study skills to succeed academically.

Cultural skills can be categorized into L1 cultural skills, target language cultural skills, and academic cultural skills. L1 cultural skills are skills and strategies English learners bring with them from their native culture. Along with L1 cultural skills, English learners need to learn skills from the English-speaking target culture. This can be done by befriending and getting help from native speakers of the target language. There is also a difference between L1 and target academic cultures. Attaining academic cultural skills involves understanding the differences in classroom and campus behavior of the target culture and knowing how to apply appropriate campus behavior. Application of target and
academic cultural skills will help English learners bridge the cultural gap and contribute to greater success in college.

Study skills are necessary for academic success. It is necessary for students to be responsible for their own academic success and to learn appropriate study skills. The two most important study skills are time management and textbook processing. Effective time management is essential to success in college. Students must then apply time management skills to reading assignments, maximizing the time spent on the task. Using this model, teachers can provide students with effective study skill strategies.

Conclusion

This discussion has resulted in a number of conclusions regarding academic competence for English learners. It is imperative that students are evaluated in the primary stages of instruction to develop an appropriate course of action for ESL/EFL instruction. This may include an assessment of native language writing, reading, and speaking skills as well as existing study habits. Once the instructor and the student have engaged in collaboration to identify existing skills and strengths, a specific plan should be developed which will promote growth and acquisition of English language skills.
It is important to develop activities tailored to the student population to encourage individual growth and academic competence.

In addition, it is critical to establish a timetable and schedule of activities for students so that they may become organized in their academic endeavors and limit in procrastination. It has been established that study skills are rarely taught; on the contrary, students are responsible for developing their own course of action regarding study habits. The establishment of a study skills plan of attack for students in the ESL classroom will undoubtedly foster growth and responsibility for English language acquisition.

Finally, it is extremely important for students in the ESL/EFL classroom to manage stress. The promotion of stress management activities and coping mechanisms will enhance academic understanding and reduce tension. Academic competence is an ongoing process that requires a significant amount of time and patience from both teachers and students, and student success will be enhanced by a strong commitment from the student and the instructor to foster academic achievement.
Technical Reading and Writing

Introduction

Writing for business or technically related purposes is sometimes difficult for native English speakers, but when non-native English speaking (NNES) professionals try to write for the American market, the results can sometimes be disastrous, and could result in serious legal implications. As an example, if a medicine bottle is labeled with the wrong instruction, an individual could take the medication following these instructions, and could possibly become ill or die. Foreign marketers may use terminology that seems appropriate, but the words may have a different meaning. Or they may use different words altogether, creating a document very different from what they may have intended to write.

Teaching technical reading and writing skills is essential to any technical writing program. Teaching goals should focus on producing writers who can write effectively for business and industry (Huckin & Olsen, 1991). This chapter deals with issues related to technical writing programs—definition and characteristics of technical communication, the difficulties posed by technical writing for English learners, and teaching strategies employed by ESL/EFL teachers.
Definition of Technical Reading and Writing

Technical writing is any writing that does not entertain the readers, such as scientific, business, and technology related documents. Lapp (1989) stated that "technical" simply means relating to a specialized field of science or technology.

Trimble (1977) defined scientific and technical rhetoric as "the process a writer, writing scientific or technical English, employs to produce a desired text" (p. 9). This process is designed to organize scientific and technical information for specific purposes and readers.

Technical writing should inform, enlighten, and communicate about business policies or technological and scientific advances to a variety of audiences. Examples of technical writing are instructions on medication bottles, owner’s instruction manuals for a variety of products, policy manuals, how-to documents, or scientific articles.

Characteristics of Technical Communication. According to Markel (1998), there are seven characteristics of technical communication: technical communication addresses particular readers, helps readers solve problems, furthers an organization’s goals, is created collaboratively, uses
design to increase readability, involves words and graphics, involves high-tech tools (p. 7).

Markel (1998) stated that the most important characteristic of technical communication is that it addresses specific readers. The writer must consider his/her audience. A person writing a proposal must intend it for a specific audience, consider the background of that audience, and anticipate how that audience will respond to what is being written. Every reader has a different set of concerns. An effective writer takes this into account, using what he/she knows about the reader to make better decisions: the kinds of decisions that will persuade the reader or more effectively communicate a particular idea.

The purpose of technical communication is not to convey the writer's imagination or to entertain readers, but to assist readers to solve problems, understand something, or to do something. A college catalog is designed specifically to guide students through process of registration. It also lists the requirements within a particular course of study, and often summarizes the content covered in a particular class. An owner's manual for a new car is much the same. The manual is a guide. It helps the reader maintain his/her vehicle. Both of these
documents are examples of technical communication. They provide the information necessary to make decisions.

Technical communication is produced by people working to further an organizational goal. For example, every department in a state government is in charge of something specific. The department in charge of programs geared towards vocational education will in itself take on many specific activities. Each of these activities will require technical communication.

In general, technical communication is created collaboratively because no one person has all the knowledge, skill, and time to put a large technical document together. The people involved in this collaborative effort (writers, editors, etc.) pool their resources to produce a document that is much more complete than anything they could have produced by themselves.

Technical communicators use design features to increase readability in order to make their documents more effective. Design features have three essential purposes. They improve the appearance of the document, which in turn makes it more appealing to the reader and creates a positive impression for the company and the writer. Design elements improve readability, allowing the reader to quickly find important information and keep track of what
they have read. Design also improves the document's intelligibility, permitting the reader to scan the document's organization visually and making it easier to understand its overall meaning.

Technical communication involves words and graphics to help the writer perform five main functions. They simplify and reinforce difficult concepts; visually clarify instructions and descriptions of objects; visually convey large amounts of quantitative data; allow non-English speakers to better understand the meaning of document; and improve the overall appearance of the document.

Technical communication is performed using high-tech tools. Every stage in the production of a technical document involves the use of a personal computer. Word-processing, desktop-publishing, and graphics software are all commonly used in the production process. As computer technology becomes more and more user-friendly and less expensive, technical writers and professionals must constantly make the effort to upgrade their skills.

The Difficulties Posed by Technical Writing for English Learners

English learners, before learning how to read or write scientific or technical English, may have been
exposed only to "general" English and may be unable to keep up with the complex structure of technical English. They also may not have had previous training in reading the complex and dense reading materials common to technical topics.

In the American culture, writing takes on a direct and concise approach; but in other cultures, writing may take an indirect approach (Smith, 1978). Second language learners who are not aware of the American writing approach are at a disadvantage, because they are not able to write clearly and concisely in English. Their writing may be seen as inferior in American culture, and their technical skills may be judged according to their writing abilities.

American writing values originality, conciseness, and accuracy. Some cultures have their own styles that may not always be concise and may not be always original (Lay, 1982). Second language learners are often at a disadvantage when learning American technical reading and writing, because they are deeply influenced by their own cultural style of technical reading and writing. They are not only trying to learn a new language and absorb a new culture, but they are also trying to overcome culturally embedded styles that influence their writing.
An example feature of technical writing is the conceptual paragraph. A thought does not begin or end with each paragraph as it does with other types of writing (Alford, 1967). This tends to confuse international students, because they are taught a basic rule of paragraph construction: that is, each paragraph must begin and end with a complete thought. This is not true of technical writing, which may take several paragraphs to convey a complete thought. According to Herber (1970), regular reading and writing differs from technical reading and writing due to different rules of the paragraph. With general paragraphs, the rules state that a paragraph must be one complete thought—and when a paragraph ends, that thought is completed. Technical paragraphs usually do not contain complete thoughts within each paragraph.

Lannon (1994) says that "conceptual" paragraphs are groups of rhetorically related concepts that develop a given generalization in a way that forms coherent and complete technical documents. The conceptual paragraph may be actually more than one physical paragraph, and may consist of a series of paragraphs that discuss the same thought in order to form a more complete unit of discussion. The second language learner, having learned how to read traditional, or "general" English, and then
required to read a technical article, may be misled into thinking that each physical paragraph is a complete thought. This can be very confusing to the English learner.

Acculturation Model. Tichenor (1993) writes about the Acculturation Model of learning a second language, which states "in order to acquire proficiency in a second language, a student must become fully acculturated into the target culture" (p. 8). It is difficult to change writing styles to accommodate the style of writing preferred in another culture, especially when one's style is bound by the native language and rhetoric.

Writing is not just about learning grammar and syntax; rather it is learning the culture that lends one to develop skills in correct and intelligent writing. If a student in an ESL/EFL class is not aware of the cultural differences, learning the language will be much more difficult than it needs to be. English learners need to understand the characteristics of each culture's preferred writing style. Baron (1998) stated that American English writing is reader oriented; French writing is writer oriented; and Japanese writing is non-person oriented. In order to achieve proficiency in a target language, the second language learner needs to become proficient in the culture.
**Business Skills.** In general, professionals in almost any business are hired for their technical skills, not their writing skills. But when a NNES employee is unable to communicate effectively, other professional skills are questioned and judged (Tichenor, 1993). NNES employees who work in the business world need to learn how to communicate using the American style of technical writing. Those who are unable to write clear technical documents may be seen as unable to make positive contributions to the company, which may lead to fewer promotions. The problems that are presented when NNES professionals are unable to write clear documents include inattention to the audience/reader and the need for better audience analysis.

**Consequences of Poor Writing Skills.** When the audience is not taken into account as documents are written, the results can be disastrous. According to Hill (1979), technical or business documents addressing the wrong audience often fail to communicate the intended message to its intended audience. ESL/EFL teachers should emphasize the need for good audience analysis to their students, so that they will be able to target their audience better.

Tichenor (1993) stated that foreign companies may not recognize the importance of high-quality written documents
when marketing and shipping their products. Even in the United States, NNES employees often write technical documents with sub-technical vocabulary, acronyms and abbreviations; and misuse words in technical documents.

Teaching Strategies Employed by English-as-a Second-Language/English-as-a-Foreign-Language Teachers

According to Mohammed-Mowafak and Swales (1984), foreign students come into a technical writing course with previous training only in “general” English. They are often not able to cope with complex reading materials, because they have not been trained for these materials. They only have knowledge of what they were taught in previous ESL/EFL classes, such as the traditional paragraph. This is confusing in itself, without even thinking about exposure to terms and definitions of words, which they may never have heard.

Therefore, it is easy to understand that English learners do not approach writing the same as do American students. Tan-San-Yee (1975) stated that students who are taught to recognize these differences would learn ultimately to recognize them without much conscious analysis. The student will then gain a more thorough and rapid comprehension of the material, and be able to write more effectively.
When students and teachers become aware of this fact, they will be able to communicate more effectively. However, while attempting to overcome these differences, students become frustrated with not being able to produce well-written technical reports. Writing teachers have a responsibility to show NNES students what Americans expect from any type of communication.

The goal of a technical writing course for English learners should be to produce students who can write well for the technical and business organizations. According to Tichenor (1993), there are three methods teachers use that help implement this goal more effectively: model teaching, re-casting, and class discussion.

**Model Teaching.** Model teaching uses model writing samples of native English speakers as a means of teaching the course. Sample documents can include anything from personal memos, and progress notes, to employee manuals. NNES students can study these to learn how their own writing and rhetoric contrasts with native speakers' writing. They then can be able to adjust their writing accordingly. This is effective in helping second language learners produce technical writing that is more native-like.
Re-casting. Re-casting is the second method used for teaching second language learners how to read and write technically in the American English style (Tichenor, 1993). For example, the English teacher assigns the class a task to write such as how to use a can opener. The teacher then shows the class his/her description of the task and NNES students can compare this to their own writing.

Class Discussion. Teachers should let their students do most of the talking in class. In that way, they are able to practice expressing themselves and will learn the language at a faster rate. The atmosphere should be informal and easy going, so that students do not have to feel the pressure in the class that they feel in their jobs.

This leads to a process approach that allows students to write, revise, and edit, using the native speakers' writing as models. It also helps them discover differences in their writing, and enables them to adjust accordingly. These methods have proved to be effective in teaching technical writing.

Conclusion

Current teaching methods must change to meet business and industry demands for high-quality foreign writers. Technical writing instructors are rarely thought of as
second language instructors; however, with more people immigrating to the United States, they cannot escape from becoming a second language instructor. It should then be noted that teaching materials need to be designed to meet these changing needs.

Teachers must be able to convey techniques for good technical writing, as well as being able convey good information concerning rhetorical differences between the writing of native and non-native speakers (Tichenor, 1993). To be motivated to learn, students need both ample opportunities to learn and steady encouragement and support of their learning efforts. Learners need to develop an understanding of the nature of second language learning, and should be cognizant of the fact that the mastery of a second language can be achieved in different ways. Using a diversity of strategies, the key factor is for learners to discover for themselves the optimal methods and techniques.

According to Tichenor, "Second language learners in the classroom and in business and industry demand that teaching methods change in the classroom. Materials that address the language and writing needs of the ESL learners need to be developed so that the quality of technical writing instruction can be maintained. The necessity for
proficiency in technical reading and writing exists not only in the classroom, but also in business and industry" (1993, p. 27). The intent of TESOL educators should be to train ESL/EFL students to be effective technical writers.

Learning Specialized Vocabulary

Introduction

Educators that provide instruction in English as a second language (ESL) and English as a foreign language (EFL) must provide students with a basic vocabulary in English in the early stages of language development. As students progress and become more familiar with the language and its idiosyncrasies, advanced training is likely to acclimate students to the daily slang as well as the complex vocabulary that they hear from native English speakers in routine conversation. It is the responsibility of the ESL/EFL instructor to provide this teaching at the appropriate juncture.

One advantageous means is the provision of specialized vocabulary. The following section provides a discussion of the concept of word elements in English. The paper continues with an analysis of the methods by which ESL/EFL instructors teach technical or specialized vocabulary in their coursework, including various learning
strategies for students. Finally, a brief discussion follows of the importance of specialized vocabulary in ESL/EFL learning.

Word Elements

The concept of learning words by breaking them into smaller parts is the foundation of English language vocabulary instruction. Most educators begin instruction with small words that are commonly used in daily conversation. It is only after these words are mastered is it feasible for English learners to begin learning longer, more complex words that can be broken down into various parts, including roots, prefixes, and suffixes.

It is extremely critical that in the early stages of English language acquisition, students are not only familiarized with the concept that various word parts exist, but also that they each possess different meanings. Therefore, word parts combine to make larger words that have various meanings based on the patterns of combinations within the words. As English learner develop a familiarity for these parts, they will often be able to define word meanings fairly quickly and effortlessly. However, many words are tricky and the meanings of word parts do not necessarily result in a clear definition for the entire word (Huckin & Olsen, 1991). Therefore, it is
often difficult to understand word meanings, particularly for students new to English.

According to Rosenthal and Rowland in their book *Academic Reading and Study Skills for International Students*, word elements are defined as parts of words that carry specific meanings (1986, p. 1). The fundamental concept is that the same word elements are used in many different words. These elements can further be broken down into prefixes, which occur at the beginning of words, and suffixes, which fall at the end of words. The understanding of specialized terminology involves the utilization of context clues, which are often defined by means of clues within the nearby text. Examples of context clues include synonyms, words that are similar to the word in question. It is only when these skills are combined that word meanings are defined in terms of a specific context and understood for their true purpose in the text.

Gairns and Redman (1986) described three forms of word building: affixation, which is the process of adding prefixes and suffixes to the base part; compounding, which is the formation of two or more words that can also stand independently as a single word (this includes three types: adjective compounds, verb compounds, and noun compounds); and conversion, which is the process by which a word may
be used in more than one way, such as a noun and a verb. Furthermore, Gairns and Redman discuss the difficulties involved in word pronunciation, which often result in a large disparity between the ability to write words in English and the ability to pronounce them correctly. Therefore, the importance of pronunciation must be emphasized in student learning in order to achieve total mastery of the English language.

Teaching Technical Vocabulary

Sight Vocabulary. Before a thorough foundation in technical vocabulary can be established, it is critical that students in ESL classrooms are prepared in the basics of sight vocabulary. Sight vocabulary is defined as words for which meanings can be defined almost instantaneously (Hill, 1979). The development of a specified curriculum and method for providing sight vocabulary instruction is critical to word recognition and development. The following suggestions directed toward the teacher of sight word vocabulary (from Huckin & Olsen, 1991):

1) Identify target words that are most important to the lesson and designate those for verbal instruction. This is directed by the importance of the word to the text, its frequency within the context of the material, its level of
difficulty, and the ability of students to develop recognition after detailed instruction has been given.

2) Evaluate student success in the development of meanings and quick recognition of target words. This can be monitored through worksheets, oral reading, and other techniques.

3) Place instructional emphasis on words which with students experience particular difficulties. Maintain a reasonable number of words taught per lesson to ensure student understanding.

4) Develop student readiness for learning the target words. Provide students with word meanings for future understanding as well as other word skills.

5) Form a connection with the graphic form of the word, its meaning, and its pronunciation. Utilize close teacher personal direction whenever possible in addition to the utilization of audiovisual equipment.

6) Allow for practice to reinforce the word meanings and associations. Utilize various instructional activities, including worksheets,
matching exercises, and use of the word in written sentences.
These techniques will foster a basic understanding and eventual mastery of the technical words located within a given text.

**Stages of Word Knowledge.** The primary step in developing a curriculum for teaching technical vocabulary is establishing the stages of word knowledge. According to Lapp, Flood, and Parnan (1989), there are three distinct levels of word knowledge: unknown, acquainted, and established. Unknown is a self-explanatory concept. Acquainted is the stage when a word’s meaning is recognized but only with much attention. Established is the stage when a word’s meaning is easily recognized and understood with little or no effort.

Technical vocabulary is often met with frustration and confusion until a well-understood meaning is established. In order to comprehend the text in which technical vocabulary is found, providing an explanation of the technical terminology found within textbooks before the reading assignment is performed may enable improved understanding of the text (Memory, 1990). However, other research demonstrates that many instructors prefer to have their students read the textbook assignments before they
are discussed in detail in the classroom (Memory, 1990). Both methods have their merits, but perhaps the most important factor in the choice should be the makeup of the student population and an accurate assessment of their levels of understanding of difficult material. The choices made by the teacher in providing instruction of technical terms may make all the difference for students struggling to understand complex words and accompanying material.

**Direct Teaching of Vocabulary.** Another strategy for the instruction of technical vocabulary incorporates the general steps required to master vocabulary terms found in Hill (1979) and goes beyond, to include the following: Visualizing the word, discussing the word, using the word, defining the word, and writing and reading the word. These five simple steps allow teachers to introduce, define, review, and reinforce technical vocabulary words so that students will better understand their meanings.

Johnson and Hwang (1983) argued that teachers who use technical terms in context before attaching formal definitions to them are more easily understood if these terms they are conveyed in visual, pictorial, or sensual connotations. Schumm (1991) contended that a combination of the following three methods of instruction will provide ease in the understanding of complex technical terms:
teacher-directed vocabulary instruction before reading, student use of a glossary before reading, and teacher-directed vocabulary instruction after reading. It should be restated that the makeup and competency level of the class population should dictate the most appropriate teaching methods to ensure success.

Coxhead (2000) demonstrated that frequency and coverage are important concepts in the selection of vocabulary. Furthermore, direct teaching through teacher explanation, vocabulary exercises, and the use of word cards for deliberate learning must be balanced with frequent opportunities to view the vocabulary in focused reading and listening in order to make the vocabulary a part of students’ working knowledge.

Students can be presented the meanings of words in a variety of ways. According to Herber (1970), a number of techniques can be used to provide instruction in technical words. Visual techniques include visuals, mime, and gesture. Verbal techniques include use of illustrative situations (oral or written), use of synonymy and definition, use of contrasts and opposites, and use of examples.

Furthermore, student-centered learning is encouraged when learning outside of the classroom. These techniques
include asking others, using a dictionary, and contextual guesswork.

Enhanced Recognition of Vocabulary. Cohen and Steinberg (1983) demonstrated a more complex theory regarding technical vocabulary instruction. The researchers indicate that technical words in science textbooks are often repeated frequently to the point that ease in reading may be greater than once thought. Furthermore, the frequent repetition of technical terms in selected text indicates that the words are vitally important in understanding the content. In ESL/EFL classrooms, this pattern of uniformity improves recognition and students' understanding of the meaning behind the words in relation to the text.

Herber (1970) demonstrated another theory regarding technical vocabulary instruction. He argued that teaching methods must be based on student competency at the time of instruction. After developing a thorough analysis of the material in question, the instructor should develop technical vocabulary lists that limit the number of words to be taught based on importance to the text and major concepts within the unit related to student abilities. Herber also argues that speeded recognition of technical vocabulary in a specific content area will increase
student accuracy in reading performance and will ultimately contribute to enhanced student abilities in reading comprehension. Various exercises can be utilized in classrooms in order to improve recognition and understanding of the terminology in a specific content area and also improve identification of formulas and other mathematic and scientific methods.

Darlington (1985) also demonstrated an effective tool for recognizing and understanding technical terminology for students. The concept of a structured overview establishes the relationships between known terms and new terms through a chart format. Perhaps the best method of introduction of the structured overview is the utilization of a recent unit that has already been studied and understood. This example provides students with the means to develop similar structures for unfamiliar material.

Once the structured overview has been established, Darlington suggests the use of two exercises to further demonstrate ease in understanding: The scrambled overview and label-object matching. The first concept involves mixing up the terms created in the structured overview, dividing the classroom into three groups, and attempting to reassemble the terms in their original format based on existing knowledge of the subject matter. The latter,
label-object matching, requires students to match words written on index cards with the objects associated with them. These techniques are just a few of the tools available to ESL/EFL teachers who provide instruction in specific content areas where technical terminology is often difficult to comprehend for new English learners.

Pearson and Johnson (1984) provided a number of other techniques and concepts related to the teaching of specialized vocabulary in ESL classrooms, including the following:

1) **Use of denotation and connotation:** Denotation means the literal meaning of a word whereas connotation means the emotions and ideas that encompass a word.

2) **Use of semantic maps:** Diagrams provide visual pictures of how words are related to one another.

3) **Use of semantic feature analysis:** Readers bring many attitudes, perceptions, ideas, and personal experiences to their reading events. Information is organized within memory banks into semantic categories, and semantic feature analyzer builds upon these categories in order to understand word meanings.
4) Use of analogies: Readers defined relate four words in a set.

5) Use of homophones: Words are presented that sound alike but possess different spellings and meanings.

This is often a source of extreme confusion for children and English learners, so instructors should heed particular attention to these often-puzzling words.

Words with multiple meanings are often another source of confusion for NNES students. These words, called polysemous words, are extremely common in the English language (Pearson & Johnson, 1984). More specifically, homographs are defined as words that are spelled alike but are pronounced differently and possess different meanings. Some examples include bow (a social grace) and bow (a fancy ribbon), and lead (to take charge) and lead (a heavy metal). Many of these concepts are particularly difficult to understand without regular practice and instruction. ESL/EFL instructors should pay particular attention to patterns of confusion that students experience in order to clarify the terms and ease understanding. Although many concepts may seem elementary in context, clearing up homograph confusion can be especially helpful for English learners.
In addition to classroom instruction and the above-mentioned techniques, students also possess one tool that can provide clarification in confusing concepts and terminology: the dictionary. The use of a dictionary should not become a habit, but it can certainly clarify confusion when no other means of assistance is available.

In addition, Gairns and Redman (1986) stated that a dictionary can serve as a backup to contextual guesswork. Contextual guesswork is defined as using the context to derive the meaning of a particular word. The ability to guess a word’s meaning is a valuable tool that allows for improved understanding of text in classroom studies. This skill may be simple for some students, whereas others may experience many difficulties in its use. When other skills are being developed, it is important not to overuse the concept of contextual guesswork because it may interfere with learning more than one subject or passage of text with ease. Finally, it should be noted that students should not be asked to utilize the concept of contextual guesswork when it is irrelevant to the learning process for a specific text. Thus the use of a dictionary retains its relevance.

Each of these techniques are valuable tools that are readily available when using a dictionary as a reference.
tool. However, the use of a dictionary can be very confusing for an English learner. Therefore, bilingual dictionaries are readily available for students in transition so that they can experience some comfort with the new language by having their native language available as they study.

**Conclusion**

ESL/EFL instructors may be responsible for providing detailed instruction to students in specific content areas, all of which involve a set of specialized vocabulary words. Therefore, it is very important for English learners to develop a foundation in word elements so that they are able to break down complex terms into parts so that they can be easily understood. Secondly, once the terms have been defined, their relationship to other words in context is also critical in order to foster a deeper understanding of the subject matter.

ESL/EFL instructors possess a number of tools and techniques that facilitate the learning of technical vocabulary. Once these tools have been implemented, it will likely be much easier for English learners to grasp the concepts involved in specialized instruction as well as the terminology. Perhaps the most important tool that educators can provide students is an accurate assessment.
of their existing abilities, strengths, and weaknesses in order to develop detailed curricula that are customized to their specific needs. These assessments will ensure successful understanding and proficiency in technical vocabulary and reading comprehension.

Background Knowledge

Introduction

Researchers have divided the skills necessary for the acquisition of second language comprehension, particularly in the reading area, into two general theories: bottom-up, text-based, psycholinguistic approaches; and top-down, socially-oriented, conceptual approaches. In each case, lack of second language comprehension is attributed to misunderstanding of some key variable of the approach. For example, bottom-up studies tend to trace miscomprehension to misunderstanding of grammar (syntax), vocabulary (semantics), or other textual aspects. Bottom-up processing is derived from the data, which is received through bottom-level schemata. Schemata are organized in a pyramid fashion from most general at the top to most specific at the bottom. Accordingly, comprehension from the bottom-up is a data-driven process (Carrell & Eisterhold, 1983).
In contrast, top-down studies primarily attribute miscomprehension to the lack of specific background knowledge or cultural familiarity that is necessary to understand the text. Top-down understanding is seen as a process that is driven by concepts (Carrell & Eisterhold, 1983). Goodman (1967) is credited with first recognizing this additional aspect of reading comprehension, although he did not use the term “top-down.” Other early researchers in this area, Steffenson, Joag-dev, and Anderson (1979), focused on cultural barriers to reading comprehension. Later work solidified this type of approach into the Schema Theory Model, where understanding involves an interaction between the background knowledge of the reader—described as the reader’s “schemata” and the text. This model has been applied to second language reading comprehension by Carrell (1983a) and Johnson (1982), among many others.

More recently, it has become obvious that the division between these two approaches is somewhat artificial, and true comprehension involves a combination of both bottom-up and top-down processing. Thus, more current research, such as the work of Bernhardt (2001), attempts to provide models that take into account the contribution of both approaches. However, investigating
the complex role of background knowledge, specifically determining the correct amount of emphasis that should be placed on various types of prior conceptual knowledge, remains a central area of study in the acquisition of comprehension within a second language.

The Definition of Background Knowledge

Investigators in this area use the terms "background knowledge" or "prior knowledge" to mean a variety of contributors to the comprehension of a reader's second language (L2). One category of background knowledge relates to the reader's knowledge of his/her first language (L1). There are two levels this particular background knowledge. First, there is the effect of merely knowing L1 and how this can alter the acquisition process of L2. This type of background knowledge brings up issues of transfer, avoidance, language loss, and rate of learning, which can collectively be termed cross-linguistic influence (Gass & Selinker, 2001).

The second level of background knowledge in this area involves the proficiency of the student in L1 and how this alters the acquisition of L2. To study this variable, comprehension of text in L1 is tested, followed by attempts to find parallels between this proficiency and the ability to understand text in L2. The work of Lee and
Schallert (1997) is an example of this type of study, and will be discussed more extensively below.

Background knowledge can also mean general knowledge of the subject matter of the text, and has been broken down into three characteristic components: familiarity, context, and transparency (Carrell, 1983b). In familiarity, the reader already possesses prior knowledge or experience of the textual content. The component of context requires additional preceding information, such as a picture or title page, which gives the reader some advance knowledge of the text’s content. Context helps the reader predict what the text will be about, therefore facilitating the reader’s top-down processing of the text. Transparency, on the other hand, facilitates the reader’s bottom-up processing of the text by providing the reader with concrete words within the text that point to the text’s broader meaning.

Studies have found significant relationships between providing or not providing these aspects of background knowledge and the overall percentage recall of passages in L2. One study relatively recent that used this classification of background knowledge is Roller and Matambo (1992).
According to Adamson (1993), the fourth and fifth components are knowledge of specific content areas and scripts for school. The former includes the ability to comprehend the American school curriculum, including all topics related to American history and subject matter concepts. The latter appears to be a subset of the cultural aspects--scripts for school. In general, when students understood how they should act in the classroom this was accompanied by an increase in success. Conflicts between scripts for school learned in other cultures and those in play in the United States were numerous. These included misinterpretation of group study as being able to do whatever the student wanted in the classroom, misunderstanding that girls need not be overly respectful to boys in the U.S., and misinterpretation of what is appropriate subject matter for study where highly moralistic and patriotic information was involved. So these school scripts form a fundamental component of the cultural aspects of background knowledge that are important to success for English-as-a-second-language (ESL) students. Whether examining the knowledge related to L1 to L2 transfer, L1 proficiency, knowledge about the text subject, cultural experience, knowledge of specific content areas, or school scripts, each researcher has
attempted to find a connection between second language comprehension and possession of particular background information.

The Schema Theory Model

It is necessary to have an operational understanding of the Schema Theory Model in order to fully appreciate the importance of background knowledge to second language comprehension. On this subject, Carrell and Eisterhold (1983) state that one of the fundamental tenets of this model is that text, either spoken or written, does not by itself carry meaning. Rather...a text provides direction for listeners or readers as to how they should retrieve or construct meaning from their own previously acquired knowledge (p. 556).

This approach differs from older work that tended to focus on the language and the meaning that can be found "within" the text, rather than on the person perceiving the language and his or her background knowledge.

A second important aspect of the schema-theoretic model is that comprehension is an interactive event between the reader or listener's background knowledge and the text itself. Each type of input is mapped against a structure of background knowledge, seeking a logical fit for the incoming information (Carrell & Eisterhold, 1983).
These structures are called schemata. The function of a schema is best illustrated with an example, originally used by Collins and Quillian (1972). It is often cited as an example of the way alternative schema could be used to interpret this sentence: “The policeman held up his hand and stopped the car.”

Here, the reader could posit two different schemata that would significantly alter the way the meaning of the text is interpreted. One would be the mental image of a traffic cop putting up his hand as a signal to the driver to stop the car. However, if the policeman was known to be a superhero, and the car was known to be driverless, a very different schema follows. There, the policeman physically places his hands on the car to bring it to a halt. Which of these two schemata the reader activates depends upon the reader having the necessary background knowledge for that schema and knowing which provides a consistent reading of the text (Carrell & Eisterhold, 1983). Through these schemata, a reader or listener comprehends, or fails to comprehend, the message of the communication.

A final issue about schema is that researchers have identified several types (Singhal, 1998). These types include content schemata, formal or textual schemata, and
linguistic or language schemata. Content schemata are what are formed based on the reader’s world knowledge, and in turn form a basis for comparison. Formal or textual schemata involve the organizational forms or structures of written texts that help reveal their meaning and can include vocabulary, grammar, and communication style. Linguistic or language schemata are more specific for decoding strategies and are what allow students to guess at the meaning of a word based on its context in a text. All three of these schemata types are applicable when all interpretations of background knowledge (language proficiency, knowledge of the subject of the text, and cultural issues) are examined from the point of view of acquiring second language comprehension.

With this grounding in the general models of background knowledge and their application to L2 education, what follows is a summary of important work examining the effect of the various types of background knowledge on L2 acquisition.

Background Knowledge and its Effect on L2 Acquisition

Background knowledge related to L1 to L2 transfer, L1 proficiency, knowledge about the text subject, cultural experience. They can be address as follows:
Cross-Linguistic Influence. In its early stages, the study of language transfer from L1 to L2 dismissed the effect of the native language as background knowledge on the acquisition of L2 (Gass & Selinker, 2001). This approach has been termed behavioristic, in that the acquisition of various English morphemes (meaningful linguistic units) seemed to follow a set behavior pattern no matter what the L1 of the student (Gass & Selinker, 2001). However, more recent research has indicated that if the right research questions are asked, significant differences can be detected, and L1 knowledge has been found to possibly have both positive effects and negative effects on acquisition of L2 (Noor, 1994). This new approach to L1 to L2 transfer has been termed the "mentalist" approach.

A good example of a negative effect of the L1 background knowledge is the phenomena of avoidance, that is the selective use of particular language structures in L2. In 1993, Laufer and Eliasson attempted to determine whether the amount of difference between L1 and L2 or the complexity of the new L2 structures was responsible. Although the exact source of avoidance remains in controversy, the only variable clearly supported by the research is the amount of difference between L1 and L2,
with greater difference correlating with greater avoidance (Laufer & Eliasson, 1993).

Overall, as noted by Gass and Selinker, the mentalist approach can be summarized as including three interacting factors to determine how language transfer will occur: “a learner’s psychotypology, perception of L1 to L2 distance, and actual knowledge of L2” (2001, p. 131). It is important to note that each of these factors has a significant background knowledge component. The exact relationship between background knowledge of L1 and transfer to L2 is still be elucidated, but there is now strong support for an existing relationship. Researchers have urged the need for more investigation in this area, particular as it relates to initial word recognition (Durgunoglu & Hancin-Bhatt, 1992).

**L1 Proficiency.** A second way to interpret the knowledge of L1 as background knowledge is by measuring the level of proficiency in the native language and see if this has an effect on L2 comprehension. In general, language proficiency can be divided into five components: communication, conceptualization, critical thinking, context, and culture (Diaz-Rico & Weed, 2002). Lee and Schallert examined the effect of L1 proficiency in their 1997 study, focusing on measuring the first three aspects.
Specifically, this study questioned whether there was a stronger correlation between L2 proficiency and L2 reading comprehension or between L1 reading ability and L2 reading comprehension. Although the study concluded that the L2 proficiency was more closely related to L2 reading ability than the L1 reading ability (background knowledge), their work did support the existence of a relationship between L1 and L2 reading abilities as well. This study was also significant in that it suggested that attaining a threshold level of language proficiency in L2 was necessary for the reader to take advantage of the "reading skills, strategies, and prior knowledge" that had been developed in L1 (Lee & Schallert, 1997, p. 733).

**Subject Matter of the Text.** A third type of study addressing the effect of background knowledge on L2 reading comprehension focuses upon supplying students with varying amounts of background information about the text before reading. The Roller and Matambo (1992) study is an example of this approach. This study utilized the breakdown of background knowledge into familiarity, context, and transparency first set forth by Carrell (1983b) to determine whether the interactions between these components could be replicated.
According to the Carrell (1983b) study, familiarity means the amount of prior exposure that the reader has had to the content area of the text and involves a subjective classification by the researchers of the text as either familiar or unfamiliar. Context is most closely related to the presentation of the materials and in many experimental designs involves either the use or nonuse of a picture to accompany the text. Finally, transparency involves the use of lexical words, where lexical means that the words used reveal the content area of the text. The study by Roller and Matambo explored key associations between improved recall and the aforementioned elements of background knowledge.

Roller and Matambo's conclusions were slightly unusual in that the students did better in English, their second language, than their native L1 and they recalled a passage classified as unfamiliar more consistently than one classified as familiar. The authors hypothesized that these effects may be related to the nature of the passages used and the cultural traditions of a British education with the students, rather than a real difference between contributions of the background knowledge.

Chen and Graves (1995) also examined the effects of providing background knowledge to readers before they
begin the test. Specifically, they provided a preview of the short story to be read (really a type of story-specific background knowledge enhancement) and/or what the researcher's termed "background knowledge" (Chen & Graves, 1995, p. 665). In this study, previewing included "text information important to the story, introduced the characters, described the plot...and gave direction for how to read the story" (Chen & Graves, 1995, p. 668-669). In contrast, background knowledge included "historical background at the time of the story . . . necessary background knowledge about the story, and culture-specific information that is needed to fully understand it" (Chen & Graves, 1995, p. 669). Thus, this study contrasted the effects of providing highly story specific information with providing more general background.

Through various measures of comprehension Chen and Graves found that previewing and a combination of previewing and background knowledge all increased the students apparent understanding of the story. However, background knowledge alone, as defined in this study, did not have a significant effect on the student's test scores. Additionally, the increase in test scores seen with the addition of the background knowledge did not
appear to justify the additional preparation time needed to include that information. Thus, the researchers concluded that the most time-efficient method was the previewing-only procedure.

Cultural Considerations. A final aspect of that has been examined by a number of researchers is the effect of the background knowledge embodied in the reader or listener’s culture. Rather than merely provide written enhancement of a cultural nature, Johnson (1982) ensured that the study participants actually lived through the cultural experience of celebrating Halloween before testing them on passages dealing with this subject matter. She concluded that prior experience in the American culture improved comprehension for English learners as measured by improved recall. The effect of this background knowledge experience appeared to be greater than other supply of information, including raw vocabulary knowledge.

A second study examining the effect the cultural background knowledge is Malik (1990). This study examined the reading behavior of students using culturally familiar and unfamiliar texts. Using a technique that determined comprehension by the ability to rank the importance of idea units, Malik found that students did much better with familiar texts than the unfamiliar. He attributed this
difference to the lack or presence of "well-developed" schemata for the different subject areas. The study also concluded that the proficient-English learners utilized both syntactic and semantic information (learning strategies) more efficiently when the text was culturally familiar.

Conclusion

It is now well established that both top-down and bottom-up approaches are necessary for proficiency in a second language. A central component of these approaches is the input of background knowledge. Background knowledge is believed to provide a schema, or source of reference, necessary for attributing a textually consistent meaning to the passage read or spoken by the student. Background knowledge can be defined in a variety of ways, including L1 knowledge or proficiency, information related to the subject matter of the text, information related to the cultural background of the text creator, or a combination of these factors. Despite some minor inconsistencies likely due to text selection issues, the research does support an important relationship between L2 language acquisition and the array of background knowledge that can be supplied by the reader or listener.
Metacognition

Introduction

Metacognition is a concept that has been the focus of research in many different disciplines and for many different purposes since John Flavell (1979) first identified “knowledge and cognition about cognitive phenomena” as an important area for study (p. 906). Beginning with this basic concept, research in this area has focused, molded, and changed what is now included within the term “metacognition.” Because it deals with awareness of thought processes, and how the thinker controls these processes, metacognition is naturally of interest to the educational community. Many educational studies have been conducted into the application of metacognitive strategies and skills for the teaching of a variety of academic subjects.

Metacognition and reading comprehension have had a particular connection due to the centrality of reading comprehension to the learning process and an awareness of the need for metacognitive skills on the part of successful readers. Metacognition skills are particularly necessary and useful when students are reading in their second language. As a result, research into the teaching
of metacognitive skills for English learner is an area just emerging as a focus of research.

The Definition of Metacognition

Research into metacognition has altered what is considered within the scope of this concept. Flavell stated that metacognition includes the ability to control a wide variety of cognitive enterprises within four classes of phenomena: "(a) metacognitive knowledge, (b) metacognitive experiences, (c) goals (or tasks), and (d) actions (or strategies)" (1979, p. 905).

According to Flavell (1979), metacognitive knowledge includes thoughts as to the person’s own nature as a thinker, the cognitive task at hand, strategies for reaching the goals of the task, and techniques for monitoring progress on the task. In other words, Flavell has divided metacognitive knowledge into three categories: "knowledge of person variables, knowledge of task variables, and knowledge of strategy variables" (1979, p. 908). For example, a student may believe that he or she has a poor memory (person variable), but still wants to remember the meaning of a particular word (task variable). In order to do this, the student could decide to repeat the meaning repeatedly (strategy variable). After doing so, the student may return to thinking about the word’s
meaning over the course of the day to ensure it is still remembered (strategy variable). All of the thoughts that direct these processes can be considered metacognition.

The work of Kluwe has further defined the meaning of metacognition. In his 1982 article, Kluwe identified two common attributes of metacognitive activities. First, the thinking individual has some knowledge about his/her own thinking and those of other persons; secondly, the thinking individual may monitor and regulate the course of his/her own thinking. Kluwe further stated that the first attribute is declarative knowledge, stored in long-term memory, and the second is procedural knowledge, stored in processes of a system. Both long-term or system memories can include metacognitive and non-metacognitive declarative or procedural knowledge.

According to Kluwe, what distinguishes metacognitive knowledge is its function to "monitor the selection and application as well as the effects of solution processes and regulate the stream of solution activity" (1982, p. 204). Kluwe called procedural knowledge of this type "executive processes" and stated that it involves decisions that identify the task, check current progress, evaluate the progress, and predict the outcome of the progress.
There are also "executive regulation processes" that "regulate the course of one's own thinking" and that involve decisions about allocating mental resources to the task, determining the order of steps to complete the task, setting the intensity of the work, and regulating the speed of the task (p. 212). Thus, by separately defining procedural and declarative knowledge, Kluwe has sharpened the definition of metacognition. According to Chamot (1987), metacognitive strategies include the following: self-management, advanced preparation, advanced organization, organizational planning, selective attention, self-monitoring and self-evaluation. These strategies are listed in the Figure 3.

To increase the value of these strategies, teachers must accurately explain their use and application to students. Explicit knowledge of a variety of strategies will allow students to generalize them to new learning activities both in and out of the classroom.
<table>
<thead>
<tr>
<th>Strategies</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-Management</td>
<td>Individuals can rearrange their learning activities to personal preferences.</td>
</tr>
<tr>
<td>Advanced Preparation</td>
<td>Planning for and rehearsing linguistic components necessary to carry out an upcoming language task.</td>
</tr>
<tr>
<td>Advanced Organization</td>
<td>Skimming the main idea and concepts of the material to be learned beforehand.</td>
</tr>
<tr>
<td>Organizational Planning</td>
<td>It can include the storyboard or parts, the sequence or order, the main ideas to be expressed orally or in writing.</td>
</tr>
<tr>
<td>Selective Attention</td>
<td>Deciding in advance to attend to specific aspects, such as scanning for key words.</td>
</tr>
<tr>
<td>Self-Monitoring</td>
<td>Used to correct a learner’s cognitive process during speaking, reading or writing.</td>
</tr>
<tr>
<td>Self-Evaluation</td>
<td>Helping learners to judge how well they have accomplished a learning task.</td>
</tr>
</tbody>
</table>

Source: Chamot, 1987, p. 77

Figure 3. Metacognitive Strategies

Metacognition and Education

Given this focus on "thinking about thinking," it is not surprising that this area of psychology has found its most direct application in the area of education. Approached from a developmental standpoint, the acquisition of metacognition distinguishes a student who is merely acquiring knowledge in an unconscious way, to a
student that has active, conscious control over that knowledge (Brown, 1980). Holt (1964) was one of the first researchers to be intrigued by the common problem of a student’s inability to understand why he or she is having problems in school, a classic expression of a lack of metacognitive thought processes. The first controlled experiments in this area were done by Markman (1977), who examined the ability of young children to know if they did not understand the task to be carried out.

More recently, educational researchers have focused on methods of teaching metacognition to help improve student learning. The role of metacognition varies from a narrow focus on improvement of a specific skill, such as reading comprehension, to broad goals such as revision of the current educational system. For example, Jacobson (1998) advocated the use of metacognition to bring the present educational system in line with the fast pace of society. Specifically, Jacobson discussed student self-direction and the teaching of metacognition in order to achieve the ideal relationship between school and society discussed by the late 20th century educator, John Dewey.

Mueller argued for the use of metacognition to improve workplace performance of graduates. Mueller
supported the skills of “analyzing, extrapolating, interpreting, and redefining” for students who are reading expository text (1997, p. 52). These skills would allow a student to perform in ways that employers expect, using self-guided reading comprehension, rather than needing direction from an authority figure.

Along similar lines, Bonds, Bonds, and Peach (1992) advocated the use of metacognition to foster independence in learning; specifically, the idea that instructors need to teach students how to think metacognitively, rather than simply learn specific information. Bonds et al. noted that metacognitive skills are the key to students’ being able to adjust their reading behavior to the difficulty level of the text; therefore, these skills could form a basis for improving the performance of below-average readers.

According to Payne and Manning (1992), applying an active comprehension-monitoring program for readers of various aptitudes using metacognitive instruction has other benefits. Not only did the students in their study retain more of what they had read and understood the purpose of the reading more fully, but the researchers actually recorded a more positive attitude about reading in general, as recorded by a Reading Attitude Inventory
(RAI) test. Payne and Manning (1992) hypothesized that this result was due to a stronger sense of purpose in reading as a task because of increased understanding of the nature of the goals of the task, as compared to students who had not been trained in metacognitive techniques.

Metacognition plays a critical role in successful learning, therefore, it is important for teachers to teach metacognition to their students.

**Differentiating Cognitive and Metacognitive Strategies**

The true distinction between metacognitive and cognitive processes is best examined through example. Metacognitive strategies can target improvement of either declarative metacognitive knowledge, such as knowledge of the ways a student learns best, or procedural metacognitive knowledge, such as how to formulate an effective study plan. Some commonly cited examples of metacognitive strategies include self-questioning and prediction of results (Livingston, 1997); identifying basic characteristics of a problem to better understand it (Mueller, 1997); self-regulation of the learning process (Jacobson, 1998); and improving the self-image of a learner (Vaidya, 1999). Specific metacognitive strategies
for reading comprehension and retention include holistic approaches that emphasize purposeful reading (Hill, 1994), active comprehension monitoring (Payne & Manning, 1992), the use of meaning-making strategies for unfamiliar text (Jimenez, Garica, & Pearson, 1996), also described as the debugging process (Brown, 1980), and acronymous metacognitive strategies, such as SQ3R (Bonds, Bonds, & Peach, 1992).

However, it is not merely enough to identify a particular strategy, such as self-questioning, to determine if it is metacognitive or cognitive. Livingston (1997) stated that it is necessary to understand the ultimate goal of the strategy in order to separate these two uses of the strategy. In particular, cognitive strategies have the goal of gaining certain knowledge, such as understanding the meaning of a passage, while metacognitive strategies have the goal of testing to ensure that this goal of understanding is reached. Livingston (1997) stated that metacognitive strategies often happen before or after a cognitive process and sometimes occur when those processes fail. Thus, metacognitive strategies can often be the response of a student when he or she does not understand and must think
about the cognitive process in order to improve their results.

Brown (1980) stated that a good example of this distinction between metacognitive and cognitive strategies is the use of the meaning-making strategies during reading, also described as the debugging process. In order even to use this strategy, a reader must first attain the metacognitive insight that they do not understand the meaning of the text. Once this occurs, the reader must slow down and attempt to give meaning to the text in question. The "debugging" process, which can be considered overall a metacognitive process, actually utilizes cognitive strategies to be ultimately successful. Bonds et al. (1992) stated that some of these processes--used for cognition in this case--might include checking back, rereading, visual representation of ideas, finding the main purpose of the passage, and identification of keywords.

**Metacognition and Study Skills**

A discussion of metacognitive strategies could not be complete without some discussion of the numerous acronym systems that have been put forth in the literature. Many such strategies exist which can help students study and retain academic material. As noted by Bonds et al. (1992),
there have been at least eight different study strategies. Each is named by an acronym to help the student remember the suggested steps. The SQ3R approach, which puts the student in control, is one of the best known of these strategies. Use of this strategy requires the student to set his or her own reading objectives and formulate questions from the text, while self-monitoring the learning process. These study strategies, and their acronyms, are summarized in Figure 4, which is taken from Bonds, Bonds and Peach (1992, p. 58).

Metacognition and Second Language Acquisition

In a very recent digest, Anderson (2002) applied the concept of metacognition to the teaching of second languages. A number of Anderson’s suggestions have been the subject of specific research projects in the second language classroom, so his organization of the material serves as a guide through a survey of the educational research that has been done in this area.

According to Anderson, metacognition is divided into five areas: (1) preparing and planning for learning, (2) selecting and using learning strategies, (3) monitoring strategy use, (4) orchestrating various strategies, and (5) evaluating strategy use and learning.
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Strategies</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>SQ3R</td>
<td>S= survey</td>
<td>The reader sets his or her own purpose for reading, develops questions to be answered, and monitors his or her learning.</td>
</tr>
<tr>
<td></td>
<td>Q= question</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R= read</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R= recite</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R= review</td>
<td></td>
</tr>
<tr>
<td>RIPS</td>
<td>R= read and reread</td>
<td>Helping students monitor their reading comprehension</td>
</tr>
<tr>
<td></td>
<td>I= imagine</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P= paraphrase</td>
<td></td>
</tr>
<tr>
<td></td>
<td>S= slow down, speed up, or seek help</td>
<td></td>
</tr>
<tr>
<td>PARS</td>
<td>P= preview</td>
<td>Useful in a variety of genres</td>
</tr>
<tr>
<td></td>
<td>A= ask questions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R= read</td>
<td></td>
</tr>
<tr>
<td></td>
<td>S= summarize</td>
<td></td>
</tr>
<tr>
<td>PQ4R</td>
<td>P= preview</td>
<td>Useful in a variety of genres</td>
</tr>
<tr>
<td></td>
<td>A= ask</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R= read</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R= reflect</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R= recite</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R= review</td>
<td></td>
</tr>
<tr>
<td>REAP</td>
<td>R= read</td>
<td>Useful in a variety of genres</td>
</tr>
<tr>
<td></td>
<td>E= encode</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A= annotate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P= ponder</td>
<td></td>
</tr>
</tbody>
</table>

Source: Bonds, Bonds, & Peach, 1992, p. 58

Figure 4. Acronym Strategies for Enhanced Study

He urged second language teachers to introduce students to strategies in all five areas (2002). These five aspects of metacognition have been investigated to various degrees by researchers studying second language learning.

Preparing and Planning for Learning. Anderson (2002) suggested the use of learning goals--both through
presentation of goals by the teacher and the application of these goals by the student. By setting concrete goals before the work begins, the student is more likely to meet expectations. Kasper (1997) examined the effectiveness of this approach in her work on evaluating the metacognitive growth of ESL writers. In this study, the students were asked to write about their approach to writing in English and given questionnaires which asked them to formulate goals for this task. The results showed a significant contrast between the class that set concrete, specific goals and received a passing grade compared to those students who did not set goals and failed—an indication of metacognitive skills in this area.

Selecting and Using Learning Strategies. Anderson (2002) stated that selecting and using learning strategies is an area of high interest when teaching a second language because of the variety of strategies available to those who are bilingual, or working to become so. This precise statement was a focus of a project done in 1996 by Jimenez, Garcia, and Pearson. In the context of reading skills, these researchers sought to differentiate unique strategies available to bilingual students, particularly when encountering unknown vocabulary. Some of the strategies observed in successful readers were contextual
and inferential strategies, cross-comparison between the different languages, and use of prior knowledge. Jimenez et al. (1996) suggested that these techniques could be taught at a metacognitive level to those bilingual students that are less successful, so that they would see their bilingualism as an asset, rather than an obstacle.

**Monitoring Strategy.** Anderson (2002) suggested a third use of metacognitive concepts in the ESL classroom--monitoring strategy use. Students use metacognitive skills, if they consider not only the actual application of a particular strategy, such as consistently monitoring for reading comprehension, but also whether the strategy is allowing them to realize the goals set for the strategy, that is, understanding more of what they are reading. This idea was the focus of Carrell in her 1988 research into the metacognitive skills of adult native speakers of Spanish and English.

Carrell (1988) found that first language reading ability was the most significant variable to determine second language reading ability in her subjects. This study concluded that training into metacognitive techniques, particularly self-monitoring the use of various reading strategies, could have a significant
impact on the effectiveness of reading in a second language.

**Orchestrating Various Strategies.** Anderson (2002) suggested a fourth aspect of metacognition: the concept of orchestrating various strategies in order to be successful. He offers an interesting example, the failure of a common reading strategy—word analysis—with the term “antimony.” Because “anti-” in this case does not mean against, breaking the word down into component parts in this case does not reveal the meaning of the word. Students must be made aware of these types of possibilities and be provided with alternative strategies, such as context or prior knowledge, in order to give meaning to this new vocabulary. This area of metacognition does not appear to have been addressed in the context of second language learning. The importance of recognizing strategy failure, thus enabling student to move on to a different approach in order to ultimately understand a new term, is an area that deserves closer inspection.

**Evaluating Strategy Use and Learning.** Anderson’s fifth application of metacognitive concepts to the teaching of a second language involves an active attempt to evaluate whether the strategies that are used are effective. In particular, he suggested students pose these
four metacognitive questions when using any particular strategy:

(1) What am I trying to accomplish? (2) What strategies am I using? (3) How well am I using the strategies? (4) What else could I do?

Zhang (2001) has studied this overarching metacognitive concept in Chinese students, using comprehensive retrospective interviews, following mentalistic data collection methods. This study found that even in the English-input-poor environment of the People’s Republic of China, success in learning English had close links with a student’s metacognitive reading strategy knowledge and their ability to evaluate the success of the various strategies available to them. Thus, the results argued for an approach similar to the four questions set forth by Anderson.

Conclusion

The application of metacognitive concepts to education has found many practical uses. Whether focus is made on self-knowledge, knowledge of tasks, or knowledge of strategies, metacognitive thinking has been found beneficial to many different types of students studying many different subjects. In particular, English learners can benefit from using metacognitive approaches.
Educational research has shown that by using learning goals, selecting and using learning strategies (particularly those uniquely available to bilingual students), carefully monitoring strategy use, and employing self-evaluation of strategies and their results, English learners can succeed more often than fail. Thus, ESL/EFL teachers are urged to instruct students in metacognitive approaches to improve their chances of successfully acquiring a second language. Researchers should continue to investigate the effects of these approaches on student learning.
CHAPTER THREE
A MODEL OF ACADEMIC COMPETENCE
FOR TECHNICAL READING IN
ENGLISH AS A SECOND LANGUAGE/
ENGLISH AS A FOREIGN LANGUAGE

Description of the Model

The previous chapter consisted of a literature review which explored different approaches to achieving academic competence in technical reading in English as a second or foreign language. Some of the concepts covered were developing English for academic competence, metacognition, background knowledge, and learning specialized vocabulary. It is necessary for Taiwanese students to learn technical reading strategies in order to acquire effective reading skills. A model of elements can be constructed from this concept (see Figure 5) which will assist ESL/EFL teachers and students to use strategies that will result in better technical reading and greater academic success (Yeh, 2001). According to Yeh’s model, academic competence can be broken down into learner strategies and academic survival strategies. Beside Yeh’s model, literacy/oracy strategies can be further categorized into technical
### Figure 5. A Model of Academic Competence for Technical Reading in English as a Second Language/English as a Foreign Language

Key: "---" Theoretical address to Yeh's model; "<-->" Background knowledge connects to learner strategies, academic/survival strategies, L1 cultural skills, TL cultural skills, and metacognition.

Source: Adapted from Yeh, 2001
reading and writing, Technical reading and writing, oracy, and other literacy, Technical reading and writing can be subdivided into model teaching, re-casting, class discussion and learning specialized vocabulary.

Academic Competence

Academic competence can be categorized into two components which are learner strategies, and academic survival strategies. Background knowledge plays a part in both of these. Students can use learner strategies in general in any academic discipline to advance their educational success. Academic survival skills are necessary for students because college is a very competitive place. Students need to prepare themselves to survive in college in order to achieve academic competence. Background knowledge is also connected to L1 and target cultural skills.

Technical Reading and Writing

The goal of a technical reading and writing course for English learners should be to produce students who can write well and read well for technical organizations. Teachers can use teaching strategies to help students achieve this goal. Literacy and oracy strategies can be categorized into technical reading and writing. The area of teaching strategies can be separated into three
subcomponents: model teaching, re-casting, and class discussion.

Model teaching uses model writing samples of native English speakers as a means of teaching the course. This is effective in helping second language learners produce technical writing that is more native-like.

Re-casting is the second method used for teaching second language learners how to read and write technically in the American English style.

Class discussion is used as teachers let their students do most of the talking in class. In that way, they are able to practice expressing themselves and will learn the language at a faster rate.

**Learning Specialized Vocabulary**

Students must learn specialized vocabulary in order to understand technical reading. Learning specialized vocabulary can be one component of technical reading and writing. Without learning technical terms, one cannot comprehend technical reading. Specialized vocabulary can be employed by teachers as a tool to facilitate technical reading. This, in turn, will make it easier for English learners to grasp the concepts in the text.
Background knowledge

It is useful for teachers to draw on students’ background knowledge before teaching a lesson. Background knowledge gives students the advantage of applying what they already know to the new ideas being presented in the text. Background knowledge can be one component of academic competence. Students can use their prior knowledge to achieve academic competence. Background knowledge also can apply to learner strategies and academic survival strategies. In addition, background knowledge and literacy/oracy strategies are related to each other because use of background knowledge can enhance literacy learning. Johnson (1982) states that background knowledge, which is linked to one’s culture, can be categorized into L1 cultural skills, target language cultural skills, and academic cultural skills. L1 culture skills are the strategies English learners use when applying knowledge acquired from their native culture. Target cultural skills are those acquired from the target culture, in this case the culture of native speakers of English. NNES students should learn to apply target cultural skills, such as making friends with native speakers and getting help from them. Applying academic cultural skills means to know and value the differences
between the academic target culture and academic L1 culture. When background knowledge is shared and reciprocated, learning can become a pleasurable experience.

**Metacognition**

Metacognition is closely related to reading comprehension because reading comprehension is central to the learning process. Metacognition can be one component of second language learning strategies. Metacognitive strategies help students to monitor and regulate their reading. Metacognitive skills are particularly necessary when students are reading in a second language, and therefore, must be applied to strategies for teaching English to English learners.

**Use of the Theoretical Model**

The model presented in this project provides teachers with methods for teaching students to apply strategies for effective technical reading. Because of the inherent difficulty of technical reading, it is important for teachers to accurately guide students in learning these strategies.

The strategies presented can make technical reading interesting and meaningful to students. The strategies can
also be applied in other areas of second language acquisition, and can result in enjoyment of the learning process and acquisition of new concepts and ideas.
CHAPTER FOUR
CURRICULUM DESIGN

Curriculum Organization

This curriculum features an instructional unit with six lessons, each based on authentic reading material (see Appendix A). The unit presents college-level reading material. The students are required to read selections from textbooks, literature, and magazines. The purpose of the lesson plan is to encourage active participation in an open learning environment. Students will learn to identify technical vocabulary and gain increased comprehension of technical texts in English as a foreign language.

Each lesson features several focus sheets, work sheets, and a self-evaluation sheets. Each lesson incorporates an assessment sheet. All lessons contain activities and ideas to help students learn technical reading. The topic of Lessons One to Six are as follows: Reading a Syllabus, The Winds of Change, The Truth about Hormones, Inside the Womb, An Introduction to Psychology and Psychologists, and Man--The Bridge Builder.

At the beginning of the class, teachers refresh students' memories and reactivate prior knowledge. The activities are intended as a warm-up, allowing students to
utilize background information and learning strategies. This warm-up will help them to better understand the topic and objectives of the lesson.

The lesson plans include focus sheets containing the reading texts; work sheets containing learning activities; and assessment sheets containing different learning assessment items. Self-evaluation sheets are also included, allowing students to monitor and evaluate their learning.

Curriculum Use of the Model

This curriculum is derived from the model in Chapter Three, as well as from the review of the five key words in Chapter Two. The following explanation of the five key words demonstrates their usefulness in this curriculum for accomplishing teaching goals (see Figure 6).

Academic Competence

An important part of helping students achieve academic competence is teaching them how to read a syllabus. Knowing how to read a syllabus allows students to set up an independent study plan. The lesson activities teach students how to identify a syllabus and set up their own study schedule in relation to the syllabus.
Additionally, the lesson activities encourage students to express their thoughts freely, and the work sheets facilitate problem-solving.

Technical Reading and Writing

The purpose of the curriculum is to improve students' reading abilities. Students will be taught how to read tables, figures, and graphs, and will work with partners to discuss these items. Technical reading and writing is divided into four strategies: Model teaching, re-casting, class discussion, and learning specialized vocabulary. In the lesson plan, these skills are taught and discussed during class so that the students can enhance their technical reading.

Learning Specialized Vocabulary

Knowledge of specialized vocabulary is an important component in technical reading comprehension. Students will learn to recognize specialized vocabulary and will work with partners to identify vocabulary words. Additionally, this exercise helps students develop thinking strategies.
<table>
<thead>
<tr>
<th>Academic Competence</th>
<th>Lessons</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Learner strategies*</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>A. Learner strategies applied to SLA</td>
<td></td>
</tr>
<tr>
<td>1. Second language learning strategies</td>
<td></td>
</tr>
<tr>
<td>a. Literacy, oracy strategies</td>
<td></td>
</tr>
<tr>
<td>i. Oracy strategies</td>
<td></td>
</tr>
<tr>
<td>ii. Other Literacy strategies</td>
<td></td>
</tr>
<tr>
<td>iii. Technical reading and writing</td>
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</tr>
<tr>
<td>a) Model teaching</td>
<td>x</td>
</tr>
<tr>
<td>b) Re-casting</td>
<td>x x x x x x</td>
</tr>
<tr>
<td>c) Class discussion</td>
<td>x x x x x x</td>
</tr>
<tr>
<td>d) Learning specialized vocabulary</td>
<td>x x x x x x</td>
</tr>
<tr>
<td>b. Cognitive, metacognitive, social-affective strategies*</td>
<td>x x x x x x</td>
</tr>
<tr>
<td>2. Second language use strategies</td>
<td></td>
</tr>
<tr>
<td>B. General strategies applied to non-SLA contexts</td>
<td></td>
</tr>
<tr>
<td>II. Academic/survival skills*</td>
<td></td>
</tr>
<tr>
<td>A. Cultural skills</td>
<td></td>
</tr>
<tr>
<td>1. L1 cultural skills*</td>
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</tr>
<tr>
<td>2. Target cultural skills*</td>
<td>x x x x x x</td>
</tr>
<tr>
<td>3. Academic cultural skills</td>
<td></td>
</tr>
<tr>
<td>B. Study skills</td>
<td></td>
</tr>
<tr>
<td>1. Time management</td>
<td></td>
</tr>
<tr>
<td>2. Text processing</td>
<td></td>
</tr>
</tbody>
</table>

* Includes use of background knowledge
(outline adapted from Yeh, 2001)

Figure 6. The Distribution of Strategies in Each Lesson

Background Knowledge

The fundamental nature of teaching is to build on and add to a student’s prior knowledge. Background knowledge can connect to learner strategies, academic/survival strategies, L1 cultural skills, TL cultural skills, and metacognition. Each lesson begins with a warm-up review of students’ memories and background knowledge. The teacher
asks topic-related questions to enhance students’ learning.

**Metacognition**

The most important element in the learning process in metacognition. This allows students to monitor, evaluate, and reflect on their learning. At the end of each lesson, the students are given self-evaluation forms for the purpose of self-monitoring and evaluating what they have learned.

In conclusion, application of these learning strategies will give students the tools to develop effective technical reading skills and academic competence. The activities in the lesson plans allow students to enjoy the learning process while developing their ability to think.

Metacognition gives students skills to become independent readers, and teaches them to plan, carry out, and accomplish reading goals. Teachers should present learning and metacognitive strategies to the class, emphasizing those strategies they feel will best benefit their students. When teachers establish a good rapport with students, they create an atmosphere of learning. Students will then take the strategies they learn in the
classroom and apply them to future learning in both English and other academic areas.
CHAPTER FIVE
ASSESSMENT

Purpose of Assessment

Reading assessment is performed for the purpose of studying, monitoring, and evaluating student’s reading behavior and progress (Johnson, 1982). This information may be complemented and verified through achievement tests. Results of reading assessment are used by ESL/EFL teachers for planning curriculum and goals. Teaching styles and learning strategies can be made more effective by studying assessment outcomes. Standardized reading assessments are mainly based on multiple-choice formats. This type of testing is limited in that it only measures the product and is not a valid reflection of the students’ actual reading ability.

Therefore, reading assessment should be more flexible in order to assess students’ real reading abilities. Teachers must focus on learning processes in order to adjust the curriculum to the students’ needs. Assessment should be used as a tool to help students enjoy learning while improving their skills, rather than a measure that puts students under pressure to produce a standardized result.
Assessment of the Curriculum Project

The curriculum featured in Appendix A has been formulated to teach students how to read technical writing. Before reading the text, the students are asked to respond to questions associated with the subject. Through this activity, students’ background knowledge is stimulated, facilitating connections to new learning experiences.

Teachers use assessment sheets in each lesson to evaluate students’ reading comprehension in order to provide opportunities for students to link comprehension to production. In Lesson One, the teacher asks students to write the course overview and rationale in their own words to check their understanding. In Lessons Two and Four, the teacher asks students to find the definition of technical terms. Comprehension of terminology is the key factor in content comprehension. In Lesson Three, the teacher evaluates the students’ learning strategies for summarizing. Through effective summarizing strategies, students will comprehend the content more effectively. In Lesson Five, to check students’ understanding, the teacher asks students to answer each of a set of given sentences
true or false. In Lesson Six, the teacher asks students to answer the questions for self-evaluation.

Students receive self-evaluation sheets at the end of every lesson with which they evaluate their learning process. They are encouraged to answer the evaluation questions candidly and freely. Teachers then use the students' responses to adjust their teaching methods and materials for the next class.

In brief, success in reading comprehension can be greatly enhanced through valid and appropriate reading assessments. Teachers must understand the assessment procedures, and they must know how to adjust their teaching styles to reflect the outcomes of the assessments.

The purpose of teaching is to help students achieve their educational goals. Assessments can be useful tools for achieving this purpose. Through assessments, teachers can gain insight into students' learning styles, and then adjust their teaching methods to benefit the students.
APPENDIX A
LESSON PLANS
Lesson One
Reading a Syllabus

Objectives:
1. Identifying the purpose of a course through the syllabus
2. Getting specific information from a syllabus
3. Designing a study schedule according to a syllabus

Materials:
Focus Sheet 1-1
Focus Sheet 1-2
Focus Sheet 1-3
Focus Sheet 1-4
Focus Sheet 1-5
Focus Sheet 1-6
Focus Sheet 1-7
Work Sheet 1-1
Work Sheet 1-2
Work Sheet 1-3
Work Sheet 1-4
Work Sheet 1-5
Work Sheet 1-6
Work Sheet 1-7
Work Sheet 1-8
Assessment Sheet 1-1
Self Evaluation Form

Warm up: The teacher asks students the following questions:
1. Do you know what a syllabus is?
2. What is the difference between a syllabus and a class schedule?

Task Chain One: Identifying the purpose of a course through the syllabus
1. The teacher provides each student with a copy of a syllabus (Focus Sheet 1-1).
2. The teacher divides students in groups of four.
3. The teacher provides students with Work Sheet 1-1.
4. The teacher asks students to complete their work sheet together.
5. The teacher asks students to spend 10 minutes discussing the syllabus. The teacher gives the discussion questions. The teacher gives students
Work Sheet 1-2. The teacher asks students to make an outline of the syllabus.

6. The teacher gives students Focus Sheet 1-2 and goes through the outline with the students.

7. The teacher gives students Work Sheet 1-3 and asks students to describe the purpose of this course in their own opinion.

8. The teacher gives students Focus Sheet 1-3 and explains the purpose of this course to the students.

Task Chain Two: Getting specific information from a syllabus

1. The teacher gives students Work Sheet 1-4 and asks students how they would contact the teacher.

2. The teacher provides students with Focus Sheet 1-4 explaining how they can contact the teacher. Students complete Work Sheet 1-4.

3. The teacher asks students where they can buy the books and where they can get the coursepack. The teacher gives students Work Sheet 1-5 and asks students to attempt it.

4. The teacher provides students with Focus Sheet 1-5 and goes through it with the students. Students then complete Work Sheet 1-5.

5. The teacher asks students to read the requirements of this course on the syllabus. Students write the requirements of this course in their own words on Work Sheet 1-6.

6. The teacher will give feedback and analysis.

7. The teacher asks students to read the Evaluation Plan on the syllabus. The teacher explains the Evaluation Plan to students.

Task Chain Three: Designing a study schedule according to a syllabus

1. The teacher asks students to read the course calendar and highlight the important parts.

2. The teacher provides students Work Sheet 1-7.

3. The teacher asks students to complete Work Sheet 1-7 together.

4. The teacher provides students with Focus Sheet 1-6 and explains it to the students.

5. The teacher gives students Work Sheet 1-8.

6. The teacher asks students to list the paper due dates on Work Sheet 1-8.
7. The teacher gives Focus Sheet 1-7 to the students and explains it.

Assessment: The teacher gives students Assessment Sheet 1-1 to checks students’ comprehension.

<table>
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</tr>
<tr>
<td>80-90</td>
<td>Good</td>
</tr>
<tr>
<td>70-80</td>
<td>Needs improvement</td>
</tr>
<tr>
<td>&lt;70</td>
<td>Study harder</td>
</tr>
</tbody>
</table>
Focus Sheet 1-1  
Sample Syllabus

CALIFORNIA STATE UNIVERSITY, SAN BERNARDINO  
College of Education

Course Title and Number: EESL 536 Crosscultural Teaching  
Section and Course ID: #109234 Section 01  
Instructor: Dr. Lynne Diaz-Rico  
Office: University Hall 401.33  
Office Hours: Monday and Tuesday, 12:00-2:00 pm  
Office Telephone: (909) 880-5658  
E-Mail: diazrico@csusb.edu  
Course Web Page: http://wct.csusb.edu:9000/  
Year/Quarter: 2002 Spring

Time/Days/Location: Monday 6:00-9:50 pm UH 042

College Vision

The College of Education of California State University, San Bernardino (CSUSB) is dedicated to the development and support of wise, reflective professional educators who will work toward a just and diverse society that embraces democratic principles. The wise teacher possesses rich subject matter knowledge; uses sound pedagogical judgment; has practical knowledge of context and culture; acknowledges the relativism associated with variations in the values and priorities of both their peers and their students; and is comfortable with the uncertainly of the outcomes of instructional decisions.
Focus Sheet 1-1 (continued)

The Mission of TESOL

TESOL as a profession promotes excellence in education for English learners and a high quality professional environment for their teachers. TESOL's mission is to develop the expertise of those involved in teaching English to speakers of other languages to help them foster effective communication in diverse settings while respecting individuals' language rights. To this end, TESOL advances standards for professional preparation and employment, continuing education, and student programs; produces high-quality programs and services, and promotes sound, research-based education policy and practices that increase awareness of the strengths and needs of English learners and furthers appreciation of diverse linguistic and cultural backgrounds.

Catalog Description

Methods and teaching techniques for teaching in multicultural and crosscultural settings in both ESL and EFL contexts. Developing cultural awareness of teachers to assist them in relating to and motivating culturally diverse students. May be offered through distance learning.

Course Overview and Rationale

This course provides an opportunity for students in the M.A. in Education, TESOL Option and other programs to expand their knowledge about the nature of culture by exploring the core values, practices and beliefs of the mainstream culture in the United States, as well as those of the cultures of students enrolled in the class. This course also offers and overview of basic issues in crosscultural communication, and a broad foundation about the influence of culture on school, the cultural practices of schooling, and the sociopolitical context of education. The course is designed to increase teachers' effectiveness in expanding non-mainstream students' access to the core curriculum, instructing all students with a multicultural curriculum, and making crosscultural connections by means of teaching practices and curricular content.
Focus Sheet 1-1 (continued)

ESL/EFL teachers with multicultural sensitivity and knowledge of crosscultural communication play a special role as cultural emissaries and mediators; as agents of welcome; and as sources of professional expertise for their colleagues. Teachers who are aware of students' needs at various stages of their adjustment to the academic demands of language learning and the stresses of life will help students to be more successful learners. To reflect this, members of the class will be expected actively to build a base of personal knowledge about culture and schooling, especially as applied to the teaching of English to non-native speakers. Every effort will be made to encourage this process by stimulating creative intellectual collaboration.

Through this process, those who teach in multicultural and crosscultural classrooms reap what they sow. If they offer cultural understanding, they receive it, if they offer language exchange, their foreign language skills grow; if they offer empathy, they grow as human beings. Teaching crossculturally is a challenge and an art.

This course is designed to offer a foundation in cultural understanding, in a manner which balances a growth in theoretical understanding with exposure to practical teaching techniques. Most importantly, it is designed to work at many levels simultaneously, so that participants can organize and verbalize what they know, make professional presentations, and grow towards a teaching career graced with knowledge, empathy, and education. The best teaching model is one that is open-ended, that furthers understanding and encourages the learners to take responsibility for what is learned, with the goal of actively reaching out to apply fundamental principles.

Teacher education is open-ended and never-ending. One goal of this course is to increase confidence in one's own teaching ability and to become a more competent teacher. This course does not use a behaviorist model of training (in which one is told exactly how to behave as a Teacher), but rather a cognitive/humanist/constructivist model of teacher education, in which one receives fundamental principles, in order to fashion one's own version of what makes a good teacher. One can never be
taught exactly how to communicate with persons of other cultural background, and such communication is fraught with the opportunity for misunderstanding. What is important is that we try, for without risking deep interpersonal interchange, we cannot grow as educators and as people.

Getting Involved in TESOL

We welcome your future participation in the M.A. in Education, TESOL Option program at CSU, San Bernardino. Applications to the program are available. Please inquire about combining the M.A. in Education, TESOL Option with a California Multiple or Single Subject teaching credential or the adult education teaching certificate.

Course Outline by Topic

1. Core values of the mainstream U.S.
2. Core values of native American cultures
3. Comparing values crossculturally
4. Learning about the learner’s culture
5. Culturally compatible teaching
6. Culture, identity, and motivation
7. Diversity and school achievement
8. Target culture as content
9. Native culture as content
10. African-American students
11. Racism, privilege, and prejudice
12. Chicano, Mex.-Am. students
13. Crosscultural studies in education
14. Intercultural communication

Many other topics will be touched upon as a part of the active interchange of ideas and experiences. Course topics have been selected in part by the active collaboration of previous students in this course. Each student is invited to volunteer topics that will make the course more useful and meaningful.
Course Goals/Objectives

The courses EESL 607 (Principles and Practices in TESOL), EESL 536 (Crosscultural Teaching), EESL 521 (Computer-Assisted Language Learning), EESL 545 (Writing in TESOL), EESL 614 (Curriculum Design in TESOL), and EESL 615 (Research in TESOL) are designed together to accomplish the twelve program goals and associated objectives. EESL 536 will focus on the following goals and objectives:

Goal 6. Relate the importance of the native and target cultures in language learning

Objective 6.1 Demonstrate an understanding of the concepts concerning the relationship between language and culture, including the importance of a teacher’s understanding the culture of the learner; the use of culturally compatible teaching techniques; way to motivate the learner to achieve a bicultural identity; techniques to teach English using the learner’s culture as well as the target culture; fundamentals of crosscultural communication patterns, comparing the learner’s culture to the English target culture; and ways to use intercultural communication to teach English.

TESOL Strategies for Culturally Based Language Teaching

Culture and Language Teaching: The Skills and Responsibilities of the Intercultural Educator
Meta-Strategy 9: Use culture to teach language

The Process of Primary Socialization
Strategy 9.1: Learn about the learner’s culture

Culturally Compatible Teaching
Strategy 9.2: Align the culture of schooling and the learner’s culture
Focus Sheet 1-1 (continued)

Culture, Identity, and Motivation
Strategy 9.3: Motivate the learner to achieve cultural fluency

Culture as Content
Strategy 9.4: Teach English using the learner's culture as well as the target culture

Crosscultural Studies
Strategy 9.5: Compare the learner’s culture to the English target culture

Using Intercultural Communication to Teach English

Knowledge, and Skills and Dispositions

Students demonstrate knowledge of...
1. Their own cultural background and values;
2. Core values of native American cultures;
3. Learner’s culture(s);
4. Ways to compare values crossculturally;
5. Culturally compatible teaching;
6. The influence of racism, privilege, and prejudice on education;
7. The influence of diversity in gender, socioeconomic status, race, ethnicity, age, lifestyle etc., on school achievement;
8. Culture, identity, motivation, and assimilation;
9. Culture of the target language as content;
10. Culture of the native language as content
11. Teaching African-American students;
12. Teaching Chicano, Mex.-Am. Students;
13. Crosscultural studies in education; and

113
Focus Sheet 1-1 (continued)

Students demonstrate skills in...

1. Cultural self-study;
2. Identifying core values of U.S. Native American cultures;
3. Ethnographic inquiry designed to investigate learners' culture(s);
4. Crosscultural values comparisons;
5. Deploying a wide repertoire of techniques in teaching and classroom organization in order to meet particular needs of learners and
6. increase access to the core curriculum for cultural and language minority students;
7. Recognizing privilege, prejudice, racism, and discrimination in the schools; and acquire techniques and strategies to confront it;
8. Articulating the influence of diversity in gender, socioeconomic status, race, ethnicity, age, lifestyle, etc., on school achievement;
9. Deepening the understanding of the cultural, identity, and motivation factors which makes the life of a member of a minority culture or a bilingual person different from that of the majority culture; recognizing a range of responses to the pressure for minorities to assimilate into mainstream culture;
10. Incorporating cultural study as content in a language course;
11. Teaching African American students;
12. Teaching Chicano and Mexican American students;
13. Studying education crossculturally; and
14. Communicating interculturally in four domains: intellectual, pedagogical, creative and interpersonal.
Focus Sheet 1-1 (continued)

Students demonstrate dispositions to...

1. Examine their own background knowledge and Beliefs, and recognize both their core values and their prejudices and make appropriate compensation for them, and examine how values affect the teacher/learner relationship;
2. Appreciate the core values of selected Native American cultures;
3. Adapt their classroom teaching to increase access to the core curriculum for cultural and language minority students;
4. Confront racism, privilege, prejudice, discrimination in the schools;
5. Facilitate students of diverse backgrounds to attain a healthy cultural identification;
6. Use the cultures of the target and the native language as they teach;
7. Appreciate cultural propensities of African American students;
8. Appreciate cultural propensities of Chicano Mexican American students;
9. Communicate comfortably with individuals of other cultures; and
10. Enjoy the fellowship of fellow professionals who teach in multicultural classrooms.

Relevant Professional Standards

Teachers of English to Speakers of Other Languages
Standards for Pre-K-12 Students

Goal 1 To use English to communicate in social settings

Standard 1 Students will use English to participate in social interactions
Standard 2 Students will interact in, through, and with spoken and written English for personal expression and enjoyment
Standard 3 Students will use learning strategies to extend their communicative competence
Focus Sheet 1-1 (continued)

Goal 2 To use English to achieve academically in all content areas
Standard 1 Students will use English to interact in the classroom
Standard 2 Students will use English to obtain, process, construct, and provide subject matter information in spoken and written form
Standard 3 Students will use appropriate learning strategies to construct and apply academic knowledge

Goal 3 To use English socially and culturally appropriate ways
Standard 1 Students will use the appropriate language variety, register, and genre according to audience, purpose, and setting
Standard 2 Students will use nonverbal communication appropriate to audience, purpose, and setting
Standard 3 Students will use appropriate strategies to extend their communicative competence

Course Requirements

Students enrolled in this course will participate in a series of dialogues using the computer-mediated communication tool Chat Room supported on the electronic learning platform WebCT. Participants will learn and practice skills of intercultural communication in intellectual and interpersonal domains by carrying out a series of two-person dialogues using aliases to encourage participants to ignore racial/cultural differences as they work together. The discourse recorded in the Chat Room logs will be analyzed according to four dimensions: 1) ideational content; 2) topic focus; 3) sociolinguistic content including evidence of interpersonal rapport moves; and 4) crosscultural conversation features, including evidence of native/non-native speaker discourse markers.
Help is Available

I will be available during office hours if you need consultation. If those hours are not convenient for you, do not hesitate to ask for an appointment at a time other than the scheduled office hours. If I can be of any assistance to you in any way, please call upon me. Note: Office hours are held under an open-door policy. If you need a private appointment, please schedule one outside of office hours.

Course Evaluation Plan

Weekly assignments will distribute the evaluation over 10 sessions.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Point Value</th>
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<tbody>
<tr>
<td>1. Reaction paper 1</td>
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<tr>
<td>2. Reaction paper 2</td>
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<tr>
<td>3. Reaction paper 3</td>
<td>25</td>
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<tr>
<td>4. Reaction paper 4</td>
<td>25</td>
</tr>
<tr>
<td>5. Reaction paper 5</td>
<td>25</td>
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<tr>
<td>6. Beige Box Material (A, B, C, D)@ 25 pts. ea.</td>
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<tr>
<td>7. Service Learning Experience (15 hrs)</td>
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<tr>
<td>8. Service Learning Reflection</td>
<td>25</td>
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<tr>
<td>9. Culture as Content Instructional Plan</td>
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<tr>
<td>(see Rubric) (will be submitted in a team)</td>
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<tr>
<td>10. Culturally Compatible Instruction paper</td>
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<td>11. Attendance</td>
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<td>TOTAL</td>
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Point value and letter grade equivalents:

- 450-500 A
- 350-399 C
- 440-449 B+
- 300-349 D
- 420-439 B
- <300 F
- 400-419 B-

Course Policies

Attendance is worth 50 pts. The first absence is valued at -10 pts; the second absence is an additional -30 pts. This constitutes the total permitted absences. The third absences and each additional absence will result in an additional -40 pts. deducted from the total points.
Focus Sheet 1-1 (continued)

...accrued by academic assignments. "Absence" is defined as "missing more than 25 percent (one hour) of class per session." Work that is submitted will only be accepted in hard-copy form (no electronic submissions). All work must be checked into the grade sheet at the time of submission to avoid possible confusion or misunderstanding. Last date of submission: Friday, June 15, 2002, noon.

The CSUSB policy on Academic Honesty

"Plagiarism and cheating are violations of the Student Discipline Code (See Appendix of the CSUSB Catalog of Programs) and may be dealt with by both the instructor and the Coordinator of Student Conduct. Plagiarism is the presentation as one's own, the ideas and writing of another. Plagiarism is academically dishonest and subjects the offending student to penalties up to and including expulsion. Students must make appropriate acknowledgments of the original source where material written or compiled by another is used.

Commitment to Diversity

In the commitment to the furthering of knowledge and fulfilling the educational mission of California State University, San Bernardino, we seek a campus climate that welcomes, celebrates, and promotes respect for the entire variety of human experience. In our commitment to diversity, we welcome people from all backgrounds and we seek to include knowledge and values from many cultures in the curriculum and extra-curricular life of the campus community. Dimensions of diversity shall include, but are not limited to, the following: race, ethnicity, religious beliefs, sexual orientation, sex/gender, disability, socioeconomic status, cultural orientation, national origin, and age (from the CSU San Bernardino University Diversity Committee Statement of Commitment to Diversity, 1995).

Statement of Reasonable Accommodations

In keeping with the university's Commitment to Diversity, the faculty of the College of Education fully support the Americans with Disabilities Act (ADA). Faculty
Focus Sheet 1-1 (continued)

will provide reasonable accommodation to any student with a disability who is registered with the Office of Services to Students with Disabilities and who needs and requests accommodation.

Language Acquisition Resource Center

The Language Acquisition Resource Center (LARC; UH 401.32) is available as a source of curriculum and materials for TESOL. It will be open during my office hours or other times. If I am in my office, I will open it for you. If not, see the secretary in Fo182 or Fo129 who will unlock the door. Do not remove materials from LARC without proper sign-out. Do not return materials to LARC: return to me during office hours (not during class)

Textbooks/Bibliography

Required


Recommended


Focus Sheet 1-1 (continued)

Supplementary

Some supplementary readings during this course will be placed on Reserve in Pfau Library: Others are included in the Coursepack, available at Campus Copy & Print, 1131 Kendall Drive Ste. 2.

Reaction paper topics (One-two pages, single-spaced):

1. Based on Heath (1985), summarize four main ways that Heath uses to show how children in Roadville use language to learn their culture. If you were raised in a similar manner, describe examples from your own life in each of these four ways that show how your language and culture were acquired like those of Roadville. If you were raised in a different way, give examples for each of these four ways that show a contrasting way of using language to learn culture. Be as detailed as you can be. In the final paragraph, give a fifth principle from your life and experience that was not covered by Chs. 1-4, using an example for illustration. This should be a six-paragraph essay:
   a) Four ways that Heath uses to show how children in Roadville use language to learn their culture
   b-e) Illustrations of these four ideas from your experience
   f) One additional idea that is distinct from the first four

2. Read Diaz-Rico, L. (1993). Summarize the difference between a multicultural/crosscultural approach to instruction and a monocultural approach. Describe a learning experience you have had that typifies the monocultural approach. Then describe how a multicultural approach would have enriched that experience.

3. Read Doutrich, D. (2000). Discuss how a cultural experience has changed your sense of self. Is there any aspect of yourself that you now consider to be bicultural? How do your friends and family react if they see you behaviors or
Focus Sheet 1-1 (continued)

values changes as a result of your cultural experiences? Be prepared to share your paper with a Chat Room partner.

4. What are the values of U.S. mainstream culture? How do these affect schooling in mainstream classrooms? Describe how this might not fit Native American values.

5. Read McIntosh (1998) and Diaz-Rico & Weed (2002), Ch. 11. What have you learned about the way power and privilege function in society? What have you learned about your own access to power and privilege?

Culturally Compatible Instruction Paper: Choose one culture of speciality that uses ESL/EFL services (the choice depends upon your career focus; Mexican, Mexican-American, Korean, Japanese, Taiwanese, Thai, etc.). Describe the teaching context you will most probably face (the "default mode") in the following four areas: monocultural curriculum, classroom routines, teaching style (see Grasha, Coursepack #12); student learning style (see Coursepack #8-11); and parent and school authorities' view of education. Describe how you will free yourself from the "default mode" by trying alternative forms of schooling in three areas: Crosscultural/multicultural content in the curriculum; teaching style, and student learning style. Next, describe how you will convince parent and school authorities to honor and value your innovations.


Learning style materials (see Coursepack #8-11)

Focus Sheet 1-1 (continued)


Crosscultural Instructional Plan: Working with a partner, adapt a lesson plan from Fantini to match the grade level you will be teaching. One member of the team should be an expert on lesson planning (Prerequisite: EESL 607).

Course Calendar

<table>
<thead>
<tr>
<th>April 1</th>
<th>No meeting. Cesar Chavez Birthday (State Holiday)</th>
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<tbody>
<tr>
<td>April 8</td>
<td>Course Preview</td>
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<td>Introduction to TESOL Strategies for</td>
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<td>handout, Coursepack #1)</td>
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<td>The Skills and Responsibilities of the</td>
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<td>Intercultural Educator Mega-Strategy 9:</td>
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<td>Use culture to teach language</td>
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Focus Sheet 1-1 (continued)

<table>
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<th>What is Culture? (see handout, Coursepack #2) Video Theater: The Primal Mind Self-Knowledge Exercise: I Was Born in the Tide of Nawn</th>
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<tbody>
<tr>
<td>FOR NEXT CLASS: Read Fantini, pp. 1-27 Read Smith, Paige, &amp; Steglitz (Coursepack #4) LOOK AHEAD: Please start on Heath (1983), on Pfau Library Reserve. This is the longest reading; it is due on April 22. There are four copies on Reserve which you may check out for four hours at a time. Please take the time to read these chapters while in the library; if you duplicate them to read at home, it breaks the book. If you feel you must duplicate these chapters to read at home, please tell the librarian who will issue you the copy that is already broken and repaired. These chapters provide a rich description and do not have to be memorized or extensively analyzed. They are the basis of Reaction Paper #1.</td>
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| April 15 | Preview Syllabus TESOL Strategies for Culturally Based Language Teaching Culture and Language Teaching: The Skills and Responsibilities of the Intercultural Educator Discuss Smith, Paige, & Steglitz Discuss Fantini, pp. 1-27 Audio Theater: M. Bennett Developing Ethnorelativism (see Coursepack #5) FOR NEXT TIME: Read Heath, Ch. 1-4 (pp. 17-148) (On Pfau Library Reserve) Read Diaz-Rico and Weed, Ch. 10, pp. 233-265 DUE NEXT TIME: Reaction Paper #1 |

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### Focus Sheet 1-1 (continued)

| April 22 | 5 pm. Computer Training: PL 1008 (Wedge)  
The Process of Primary Socialization  
Strategy 9.1: Learn about the Learner’s culture  
Lecture: Ethnographic Study  
Multicultural education: Curriculum  
Socialization in Roadville and Trackton  
DUE TODAY: Reaction Paper #1  
FOR NEXT TIME:  
Read Falk P. 1-63 (Chs. 1-3). COMPLETE ALL MATERIAL in BEIGE BOXES (Beige Box Assignment #A)  
Read Diaz-Rico (1993) From Monocultural to Multicultural... (Coursepack #6)  
DUE NEXT TIME: Reaction Paper #2  
DUE NEXT TIMW: Beige Box Assignment #A (Falk Chs. 1-3) |
| --- | --- |
| April 29 | Cultural Tour: New England  
Culturally Compatible Teaching  
Strategy 9.2: Align the culture of schooling and the learner’s culture  
What is an Instructional Conversation? (see Coursepack #7)  
What Makes a Conversation Meaningful?  
Instructional Conversation: Culturally Compatible Teaching  
DUE TODAY: Reaction Paper #2  
Due TODAY: Beige Box Assignment #A (Chs. 1-3)  
FOR NEXT TIME:  
Read Fantini, pp. 28-46  
Read Falk pp. 64-99 (Chs. 4-5). COMPLETE ALL MATERIAL IN BEIGE BOXES (Beige Box Assignment #B)  
DUE NEXT TIME: Beige Box Assignment #B (Chs. 4-5)  
DUE NEXT TIME: Culturally Compatible Instruction (see Coursepack #8-12) |
Focus Sheet 1-1 (continued)

| May 6    | Cultural Tour: Dixie  
|          | Teaching African American students (see Coursepack #13)  
|          | Video Theater: Interview with Dr. Henry and Dr. Young  
|          | CHAT ROOM A: African American Poem  
|          | DUE TODAY: Beige Box Assignment #B (Ch. 4-5)  
|          | DUE TODAY: Culturally Compatible Instruction  
|          | FOR NEXT TIME:  
|          | - Read Fantini, Parts II & III  
|          | - Read Dourtich (Coursepack #14)  
|          | - Read Falk, pp. 100-132. Chs. 6-7.  
|          | COMPLETE MATERIAL IN BEIGE BOXES  
|          | (Beige Box Assignment #C)  
|          | DUE NEXT TIME: Reaction Paper #3  
|          | DUE NEXT TIME: Beige Box Assignment #C (Chs. 6-7)  

| May 13   | Culture, Identity, and Motivation  
|          | Strategy 9.3: Motivate the learner to achieve cultural fluency  
|          | Discuss Fantini Parts I, II & III  
|          | Accommodation: Mainstream/minority cultures  
|          | CHAT ROOM B: The Self Across Cultures  
|          | DUE TODAY: Reaction Paper #3  
|          | DUE TODAY: Beige Box Assignment #C (Chs. 6-7)  
|          | FOR NEXT TIME:  
|          | - Read Fantini, Part IV  
|          | DUE NEXT TIME: Crosscultural Instructional Plan  

| May 20   | Culture as Content  
|          | Strategy 9.4: Teach English using the learner’s culture as well as the target culture  
|          | Cultural Lessons from Fantini, Part IV  
|          | DUE TODAY: Crosscultural Instructional Plan  
|          | FOR NEXT TIME:  
|          | - Read Falk p. 133-170 (Chs. 8-9). COMPLETE All BEIGE BOXES(Beige Box Assignment #D)  
|          | - Read Katz, Hsu, Lind, Spindler & Spindler, Reiten on the Lakota Sioux, a brief Description of the Navajo Way, Locust, Respect for Native Peoples(from website)  

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Focus Sheet 1-1 (continued)

| (Coursepack #15-22)                                                                 |   |
| ---                                                                                   |   |
| DUE NEXT TIME: Beige Box Assignment #D (Chs. 8-9)                                     |   |
| DUE NEXT TIME: Complete Checklist for Personal Values (CP #23)                        |   |
| DUE NEXT TIME: Reaction Paper #4                                                     |   |

<table>
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<tr>
<td>HOLIDAY: Memorial Day. No Class</td>
<td>Beliefs and values of U.S. mainstream America</td>
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<td>Beliefs and values of primal cultures</td>
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<td>Video Theater: Pow Wow regalia; Interview with Lynn LeRoy</td>
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<td>Crosscultural Studies</td>
<td>Strategy 9.5: Compare the learner's culture to the English</td>
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<td>Instructional Conversation: The Values of Mainstream U.S.</td>
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<td></td>
<td>Culture: My Likes and Dislikes</td>
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<td>DUE TODAY: Reaction Paper #4</td>
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<td>FOR NEXT TIME:</td>
<td>Read McIntosh (1988) (Coursepack #24)</td>
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<tr>
<td></td>
<td>Read Díaz-Rico &amp; Weed (2002), Ch. 11</td>
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<tr>
<td>Racism, Discrimination, Prejudice, and Privilege Video Theater: Just Like You</td>
<td>CHAT ROOM C: My Experiences with Power and Privilege</td>
</tr>
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<td>FOR NEXT TIME:</td>
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<td></td>
<td>Read Fantini, Part V</td>
</tr>
<tr>
<td>DUE NEXT TIME: Service Learning Reflection (see Rubric) (Coursepack #27)</td>
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</table>
Focus Sheet 1-1 (continued)

| June 10 | Using Intercultural Communication to Teach English  
|         | Strategy 9.6: Use intercultural communication to teach English  
|         | Discuss Fantini, Part V  
|         | Discuss the Service Learning Experience  
|         | Teaching Mexican Americans and Chicanos (see Coursepack #25-26)  
|         | Video Theater: La Vida de Maria; Interview with Dr. Valdez  
|         | DUE TODAY: Service Learning Reflection |

Because of the Cesar Chavez holiday, the class is scheduled to meet for only nine sessions. We will be scheduling an additional class to constitute ten sessions. This additional class will take the place of the final examination.

We welcome your future participation in the M.A. in Education, TESOL Option program at CSU, San Bernardino. Please feel free to keep in touch by phone or mail. I’d like to hear your success stories, or to be of help with your concerns.

Focus Sheet 1-2
Outline of Syllabus

1. College Vision
2. The Mission of TESOL
3. Catalog Description
4. Course Overview and Rationale
5. Getting Involved in TESOL
6. Course Outline by Topic
7. Course Goals/Objectives
8. TESOL Strategies for Culturally Based Language Teaching
9. Knowledge, Skills and Dispositions
10. Relevant Professional Standards
11. Course Requirements
12. Help is Available
13. Course Evaluation Plan
14. Course policies
15. The CSUSB Policy on Academic Honesty
16. Commitment to Diversity
17. Statement of Reasonable Accommodations
18. Language Acquisition Resource Center
19. Textbooks/Bibliography
20. Reaction paper topics
21. Course Calendar
Focus Sheet 1-3
The Purpose of the Course

Methods and teaching techniques for teaching in multicultural and crosscultural settings in both ESL and EFL contexts. Developing cultural awareness of teachers to assist them in relating to and motivating culturally diverse students. May be offered through distance learning.
Focus Sheet 1-4
Ways to Contact the Teacher

1. E-Mail: diazrico@csusb.edu
2. Office: University Hall 401.33
3. Office Hours: Monday and Tuesday, 12:00-2:00 PM
4. Office Telephone: (909) 880-5658
5. Help is Available

I will be available during office hours if you need consultation. If those hours are not convenient for you, do not hesitate to ask for an appointment at a time other than the scheduled office hours. If I can be of any assistance to you in any way, please call upon me. Note: Office hours are held under an open-door policy. If you need a private appointment, please schedule one outside of office hours.
How you can get the books:

1. College bookstore
2. Web Site: www.amazon.com

How you can get the coursepack:

1. Campus Copy & Print
   1331 W. Kendall Dr. #2
   San Bernardino, CA 92407
   909-880-2323
## Focus Sheet 1-6
### Study Plan

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<td>Read Fantini, pp. 1-27</td>
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<td>Read Smith, Paige &amp; Steglitz (Coursepack #4)</td>
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<td>Read Heath, Chs. 1-4 (pp.17-148)</td>
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<td>Read Diaz-Rico and Weed, Ch. 10, pp. 233-265</td>
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<td>Read Falk pp. 1-63 (Chs.1-3)</td>
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<td>Read Diaz-Rico (1993) From Monocultural to Multicultural...</td>
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<td>(Coursepack #6)</td>
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<td>May 6</td>
<td>Read Fantini, Parts II &amp; III</td>
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<td>Read Doutrich (Coursepack #14)</td>
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<td>Read Falk, (pp. 100-132). Chs. 6-7.</td>
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<td>Read Falk pp. 133-170 (Chs. 8-9).</td>
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<td></td>
<td>Read Katz, Hsu, Lind, Spindler &amp; Spindler, Reiten on the Lakota Sioux, a brief description of the Navajo Way, Locust, Respect for Native Peoples (from website) (Coursepack #15-22)</td>
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<td>Read Diaz-Rico &amp; Weed (2002), Ch. 11</td>
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# Focus Sheet 1-7
## Paper Due Date

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<tr>
<td>April 22</td>
<td>Reaction Paper #1</td>
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<td>Beige Box Assignment #B, Culturally Compatible Instruction</td>
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<td>Reaction Paper #3</td>
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<td>June 10</td>
<td>Service Learning Reflection</td>
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</table>
1. What is the difference between a syllabus and a class schedule?

2. What do you expect to learn in this course?

3. How do you expect the teacher to help you with this course?
Make an outline of the syllabus.
Work Sheet 1-3
The Purpose of This Course

1. Describe the purpose of this course in your own words.

2. According to the syllabus, what is the purpose of this course?
Work Sheet 1-4
Contacting the Teacher

1. Name at least two ways that you can contact your teacher.

2. According to syllabus, what are the ways you can contact your teacher?
Work Sheet 1-5
Directions

Without looking at the syllabus, describe where you can get the following materials.

1. Books

2. Coursepack
Work Sheet 1-6
Requirements of this Course

Write the requirements of this course in your own words.
Work Sheet 1-7
Study Plan

Read the syllabus and then write the study plan in your own words. If you read the assignment, check “Yes.” If you didn’t read the assignment, check “No.”

<table>
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<tr>
<th>Date</th>
<th>Study Plan</th>
<th>Yes</th>
<th>No</th>
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Work Sheet 1-8
Paper Due Date

Check the paper due dates on the syllabus and write them in the spaces below. If you wrote the paper, check "Yes." If you didn’t write the paper, check "No."

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<th>Date</th>
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The teacher asks students to write down the Course Overview and Rationale in their own words.

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<th>Sample Answer</th>
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<td>1. To whom is the course directed? (10 ea.)</td>
<td>MA students of TESOL and other students</td>
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<tr>
<td>2. Three ways the course expands students' knowledge (10 ea.)</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>3. The basic issue that is covered (10 ea.)</td>
<td></td>
<td>30</td>
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<tr>
<td>4. What three ways will the course improve the teacher's effectiveness? (10 ea.)</td>
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<td>30</td>
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<tr>
<td>Total</td>
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Self Evaluation Form

Name:

Score:

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<tr>
<th>Criteria</th>
<th>Myself</th>
<th>Group</th>
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<tr>
<td>I learned how to identify the purpose of syllabus.</td>
<td>5 4 3 2 1</td>
<td>5 4 3 2 1</td>
</tr>
<tr>
<td>I know the purpose of this course.</td>
<td>5 4 3 2 1</td>
<td>5 4 3 2 1</td>
</tr>
<tr>
<td>I learned how to design my own study plan.</td>
<td>5 4 3 2 1</td>
<td>5 4 3 2 1</td>
</tr>
<tr>
<td>I made myself understood during the discussion.</td>
<td>5 4 3 2 1</td>
<td>5 4 3 2 1</td>
</tr>
<tr>
<td>I worked well with my group.</td>
<td>5 4 3 2 1</td>
<td>5 4 3 2 1</td>
</tr>
</tbody>
</table>

5: excellent
4: good
3: average
2: needs improvement
1: poor

How can I improve my learning?

How can I define the syllabus?
Lesson Two
The Winds of Change

Objectives:
1. To acquire a general knowledge of the world’s energy systems
2. To be able to identify key terminology
3. To survey technical reading and writing strategies
4. To understand graphic organizers

Materials:
Focus Sheet 2-1
Focus Sheet 2-2
Focus Sheet 2-3
Focus Sheet 2-4
Work Sheet 2-1
Work Sheet 2-2
Work Sheet 2-3
Assessment Sheet 2-1
Self Evaluation Form

Warm-up: The instructor asks students the follow questions:
1. What is the function of windmills?
2. How does the wind change seasonally?

Task Chain One: To build a general knowledge of the world’s energy systems
1. The teacher provides students with Focus Sheet 2-1 (The Winds of Change).
2. The teacher asks students to read the article working in groups of four.
3. The teacher asks each group to report an important point about the article to the class.

Task Chain Two: To identify key terminology
1. The teacher asks students to define 10 terms from Focus Sheet 2-1.
2. The teacher asks students to write down 10 words in Work Sheet 2-1.
3. The teacher asks each group to explain why they chose the words they did. Usually, students will choose the words they are not familiar with instead of the ones that are important.
4. The teacher distributes Focus Sheet 2-2. This sheet explains how to recognize important vocabulary words within context.
5. The teacher gives students feedback and analyzes their errors.

Task Chain Three: To survey technical reading and writing Strategies
1. The teacher distributes Focus Sheet 2-3.
2. The teacher gives students tips on how to study technical writing and how to read effectively.
3. Students search for characteristics of technical reading in Focus Sheet 2-1 using the criteria on Focus Sheet 2-3.
4. Students write down their definitions of characteristics of technical writing.
5. The teacher gives students Work Sheet 2-2. Students discuss the exercise and answer questions in their groups.
6. Groups share their answers to the exercise with the class and the class brainstorms about better study techniques.

Task Chain Four: To understand graphic organizers
1. The teacher gives students Focus Sheet 2-4.
2. The teacher explains Focus Sheet 2-4 to students.
3. The teacher asks students to do Work Sheet 2-3.

Assessment: The teacher gives students Assessment Sheet 2-1 to check students’ understanding.

<table>
<thead>
<tr>
<th>Score</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>90-100</td>
<td>Excellent</td>
</tr>
<tr>
<td>80-90</td>
<td>Good</td>
</tr>
<tr>
<td>70-80</td>
<td>Needs improvement</td>
</tr>
<tr>
<td>&lt;70</td>
<td>Study harder</td>
</tr>
</tbody>
</table>
Focus Sheet 2-1
The Winds of Change

Over the Columbia River, on a high desert ridge, the world’s largest wind farm sprawls across 50 sq. mi. of Oregon and Washington. When the last of its 460 turbines are installed, this postmodern power plant will offer clean electricity to 70,000 homes and businesses. Every month hundreds of tourists come to gawk at its fiber-glass blades, twirling with ballistic grace atop 160-ft. poles. “People are in awe of wind power,” says Anne Walsh, community-relations manager of the Stateline Energy Center.

And guess what? Wind is becoming more than a quixotic sideshow. It’s now the world’s fastest growing power source—a high-tech challenge to the coal mines, oil rigs, nuclear reactors and hydroelectric dams that seem, well, so 20th century. Experts say wind could provide up to 12% of the earth’s electricity within two decades. Wind farms in Texas, Oregon, Kansas and elsewhere helped lift U.S. wind-energy output 66% last year, and an additional $3 billion in American projects are in the works. “Wind is competitive,” wrote Mark Moody-Stewart, the former chairman of Royal Dutch/Shell who now co-chairs an alternative-energy task force for the Group of Eight, in a recent report. “This is not something to look forward to for the future—-it is here today.”

The promise is tantalizing. Windmills generate renewable power, so called because the source of the energy, wind, is continually renewed by nature (ditto for solar cells, which are powered by the sun; geothermal systems, which use the earth’s heat; and hydroelectricity, which flows from dams). Unlike oil and coal deposits, renewable energy can’t be exhausted, at least not until the sun burns out billions of years from now and earth goes cold.

Skeptics may recall the burst of enthusiasm for conservation and renewable power when oil prices quadrupled in the 1970s. State-funded energy research and development surged, while tax incentives boosted solar, wind and other alternatives to petroleum and the atom. But once oil supplies loosened and prices dropped, governments lost interest. In the U.S., rules requiring
more fuel-efficient cars were rolled back, in California, subsidies evaporated, pushing wind companies into bankruptcy. "It is a moral disgrace the we have done so little to reduce our dependence on imported oil and oil generally," says Reid Detchon, a former U.S. Energy Department official who now consults for the United Nations Foundation.

But the need to diversify is now more urgent and the consensus to do so greater than when OPEC first played bully. Global energy demand is expected to triple by mid-century. The earth is unlikely to run out of fossil fuels by then, given its vast reserves of coal, but it seems unthinkable that we will continue to use them as we do now, for nearly 80% of our energy. It’s not just a question of supply and price, or even of the diseases caused by filthy air. We know that global warming from heat-trapping carbon dioxide, a by-product of fossil fuel burning, threatens to cause chaos with the world’s climate. And the terrorist assault of the World Trade Center raises other scary scenarios: how much easier would it be to crack open the Trans-Alaska pipeline and how much deadlier would it be to bomb a nuclear plant than to attack a wind farm?

Clean energy has a long way to go. Only 2.2% of the world’s energy comes from “new” renewables such as small hydroelectric dams, wind, solar and geothermal. (Traditional renewable energy from large dams provides another 2.2%.) How to boost that share—and at what pace—is debated in industrialized nations—from Japan, which imports 99.97% of its oil, to Germany, where the nearby Chernobyl accident turned the public against nuclear plants, to the U.S., where the Bush Administration has strong ties to the oil industry. But the momentum toward clean renewables is undeniable. Globally, solar- and wind-energy output is growing more than 30% annually—far faster than conventionally fuels—and their cost is plummeting. "We are on the cusp of an energy revolution," says Christopher Flavin, president of the World-watch Institute, a Washington non-profit. "It will be as profound as the one that ushered in the age of oil a century ago."

Even oil companies are trying to cash in on the decarbonization trend. The world had gradually moved
Focus Sheet 2-1 (continued)

toward cleaner fuels—from wood to coal, from coal to oil and from oil to natural gas. Renewables are the next step. Royal Dutch/Shell has pledged to spend up to $1 billion on renewables through the next five years. Japanese manufacturers, led by Sharp and Kyocera, have moved aggressively into photovoltaic cells, which turn sunlight into electricity. And in April General Electric snapped up Enron Wind from the bankrupt energy giant. “We are on a journey to lower-carbon world,” says Graham Baxter, an executive at Britain’s BP, which is building a $100 million solar plant in Spain.

How soon we reach an era of clean, inexhaustible energy depends on technology. Solar and wind energies are intermittent: when the sky is cloudy or the breeze dies down, fossil fuel or nuclear plants must kick in to compensate. But scientists are working on better ways to store electricity from renewable sources. Current from wind, solar or geothermal energy can be used to extract hydrogen from water molecules. In the future, hydrogen could be stored in tanks, and when energy is needed, the gas could be run through a fuel cell, a device that combines hydrogen with oxygen. The result: pollution-free electricity, with water as the only by-product. Already fuel-cell buses, cars and small generators are being tested. Eventually, some visionaries say, fuel cells placed in individual buildings could replace many of today’s giant electric plants. But that will not happen unless the technology is refined and the cost drops. “A hydrogen economy,” says Alan Nogee of the Union of Concerned Scientists, a U.S. environmental group, “is the Holy Grail.”

While the developed nations debate how to fuel their power plants, however, some 1.6 billion people—a quarter of the globe’s population—have no access to electricity or gasoline. They cannot refrigerate food or medicine, pump well water, power a tractor, make a phone call, or turned on an electric light to do homework. Many spend their days collecting firewood and cow dung, burning it in primitive stoves that belch smoke into their lungs. To emerge from poverty, they need modern energy, and renewables can help, from village-scale hydropower to household photovoltaic systems to bio-gas stoves that convert dung into fuel. More than a million rural homes
in developing countries get electricity from solar cells. "The potential is enormous," says Anil Cabralal, an energy specialist for the World Bank, which has helped finance 500,000 residential solar systems from Argentina to Sri Lanka.

Ultimately, the earth can meet its energy needs without fouling the environment. "But it won’t happen," asserts Thomas Johansson, an energy adviser to the United Nations Development Program, "without the political will." To begin with, widespread government subsidies for fossil fuels and nuclear energy—estimated at some $150 billion per year—must be dismantled to level the playing field for renewables. Policymakers must factor in the price of pollution: coal plants are more expensive than renewable power when one includes the cost of scrubbers on smokestacks and the expense of health care for coal-related illnesses; nuclear energy costs would soar without government insurance. Environmentalists are calling for taxes on carbon to slow the growth of fossil-fuel use.

Another way to increase renewables’ share of the energy mix is to reduce the use of conventional fuel through efficiency incentives. Experts estimate that efficiency could slash the globe’s projected energy consumption by a third. Strict standards can cut energy use in everything from air conditioners to cars. Compact fluorescent lamps use a quarter of the electricity of incandescent bulbs to provide the same amount of light.

Governments are increasingly forcing utilities to make it easier for windmill and solar-panel owners to connect to the grid and get credit for providing extra electricity they don’t use. Governments are also pressuring utilities to meet targets for renewable sources of energy. The European Union, for instance, is requiring its members to boost electricity from renewables to 22% of production within the next eight years. Brazil plans to push a global standard at the World Summit on Sustainable Development in Johannesburg this month.

On the road to enlightened energy policy, a few countries offer models of reform. More than a decade ago, Denmark required utilities to purchase any available renewable energy and pay a premium price; today the
country gets 18% of its electricity from wind. Thanks largely to Germany and Spain, which have enacted vigorous incentives for renewables, Europe today accounts for 70% of the world’s wind power. In Japan, 80,000 households have installed solar roof panels since the government offered generous subsidies in 1884; consequently, Japan has displaced the U.S. as the world’s leading manufacturer of photovoltaics. India established a fund that has lent $1.1 billion to alternative-energy projects; the country is now the globe’s fifth largest generator of wind and solar power. Iceland, which lies on a hotbed of underground volcanic activity, uses that geothermal energy to heat 90% of its buildings. The island nation is planning to use geothermal and hydroelectric power to produce large amounts of hydrogen, creating the world’s first hydrogen economy.

Such examples show that the future “is more a matter of choice than destiny,” as Brazilian physicist Jose Goldemberg, the chairman of a recent United Nations energy study, put it. On the windy border of Washington and Oregon, citizen groups are already making a choice. They have pressured utilities to invest in green energy, and a federal tax credit has made it more profitable. “It’s the right thing to do,” says Vito Giarrusso, manager of the Stateline wind farm, “to help our little piece of the earth.”

Focus Sheet 2-2
Vocabulary Identification Strategies

The important vocabulary words are not only just the ones you do not know. What makes a vocabulary word important is that the word accurately describes a key character, important event, idea, or theme in the article.

After knowing how to select important words from an article, you have to learn how to memorize them. First, you have to know the definition of the word. You can consult a dictionary to find it. Second, you have to have contextual knowledge of the word. You have to observe the use of word from different contexts in order to develop your own contextual knowledge. Moreover, you have to know how to use the word in different contexts.

Specific writing that science or engineering students read is commonly called technical writing. Reading technical writing is an important part of many academic disciplines. Technical reading skills are essential in both the everyday and academic world. The following will describe technical writing and offer suggestions for reading it effectively.

1. What are the characteristics of technical writing?

<table>
<thead>
<tr>
<th>Characteristics of Technical Writing</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose</td>
<td>To supply the readers with needed information. To perform a task, understand a situation, solve a problem, and make a decision.</td>
</tr>
<tr>
<td>Fact density</td>
<td>Facts are abundant and usually are presented as compactly as possible.</td>
</tr>
<tr>
<td>Exact word choice</td>
<td>Meaning must be clear and without possibility of confusion or misinterpretation.</td>
</tr>
<tr>
<td>Technical/specialized vocabulary</td>
<td>These words have specific meanings within the field or discipline and often serve as shortcuts to lengthy descriptions or details that would be necessary if using non-specialized language.</td>
</tr>
</tbody>
</table>
Abbreviation and notation systems

An extensive system of abbreviation and notation (signs and symbols) is used. These are also shortcuts to writing out complete words or meanings and are often used in diagram, formulas, and drawings.

Graphics

Most technical writing contains numerous drawings, charts, tables, diagrams, or graphs. They are included to clarify, help you to visualize, and emphasize key information.

Examples and sample problems

Technical textbooks often contain numerous examples and sample problems. These are included to illustrate how information is used and instructions are applied.

Specific formats

Technical writing often follows specific organization. A psychologist’s case report has specific categories. Research reports in the science typically have a statement of problem, a description of experimental design, and so forth.

Study Technical Material

- Study daily:
  Frequent contact with the material is necessary if you are to remember it.
- Reserve large blocks of time:
  Large blocks of time are necessary to complete projects, lab write-ups, or problem sets.
- Learn technical vocabulary:
Focus Sheet 2-3 (continued)

Understanding the technical vocabulary in your discipline is essential. It helps you to establish yourself as a professional in the field and to communicate effectively with other professionals.

► Study by drawing diagrams and pictures:
   Be concerned with describing parts or processes and do not worry about artwork or scale drawing.

► Focus on concepts and principles:
   Technical subjects are detailed; many students get lost in details and lost sight of the concepts and principles to which the details relate.

► Use the glossary and index
   Due to the large number of technical terms, formulas, and notations, it is necessary to refer to definitions and explanation continued in a glossary or index.

► Use outlining
   Outlining is an effective study and review technique that helps you to decide what information is important and how it is related.

Focus Sheet 2-4
Learning Charts Reading

Four types of charts are commonly used in college textbooks: pie charts, organization charts, flowcharts, and pictograms. Each is intended to display relationships, either quantitative or cause-effect.

Pie Charts
Pie charts are used to show whole/part relationships or to show how given parts of a unit have been divided or classified. They let the reader compare the parts to each other as well as compare each part to the whole.

Organizational Charts
An organizational chart divides an organization, such as a corporation, a hospital, or a university, into its administrative parts, staff positions, or lines of authority.
Flowcharts
A flowchart is a specialized type of chart that shows how a process or procedure works. Lines or arrows are used to indicate the direction (route or routes) through the procedure. Various shapes (boxes, circles, rectangles) enclose what is done at each stage or step. You can draw, for example, a flowchart to describe how to finish writing your thesis.

![Flowchart Example]

To read flowcharts effectively, use the following suggestions:
1. Decide what process the flow chart shows.
2. Follow the chart, using the arrows and reading each step. Start at the top or far left of the chart.
3. When you're finished, describe the process in your own words. Compare your drawing with the chart and take note of anything you forgot or misplaced.

Pictograms
A pictogram is the combination of a chart and a graph. It uses symbols or drawing, instead of numbers, to represent specified amounts. This type of chart tends to be visually appealing, makes statistics seem realistic, and may carry an emotional impact.

Work Sheet 2-1

After you know how to identify the important vocabulary words from an article, work with your group to identify the 10 most important terms and tell the other groups your reasons. You can write down your notes, which may include definition, examples, and the reason why it is important on the following space when you listen to the presentation from the other groups.

1. Vocabulary word:
   - definition
   - examples
   - reasons

2. Vocabulary word:
   - definition
   - examples
   - reasons

3. Vocabulary word:
   - definition
   - examples
   - reasons

4. Vocabulary word:
   - definition
   - examples
   - reasons

5. Vocabulary word:
   - definition
   - examples
   - reasons

6. Vocabulary word:
   - definition
   - examples
   - reasons
7. Vocabulary word:

<table>
<thead>
<tr>
<th>Definition</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>examples</td>
<td></td>
</tr>
<tr>
<td>reasons</td>
<td></td>
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</tbody>
</table>

8. Vocabulary word:

<table>
<thead>
<tr>
<th>definition</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>examples</td>
<td></td>
</tr>
<tr>
<td>reasons</td>
<td></td>
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</table>

9. Vocabulary word:

<table>
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<th>definition</th>
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<tr>
<td>examples</td>
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<tr>
<td>reasons</td>
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10. Vocabulary word:

<table>
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<th></th>
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<tbody>
<tr>
<td>examples</td>
<td></td>
</tr>
<tr>
<td>reasons</td>
<td></td>
</tr>
</tbody>
</table>
Elaine is a liberal arts major who is taking a biology class to fulfill her science requirement. Her reading assignment for this week includes a chapter on plant reproduction and development. It includes numerous complicated diagrams of reproductive life cycles of conifers (a type of evergreen tree) and flowering plants. Elaine is unsure how to approach reading and understanding the material. She is also frustrated because some of the diagrams appear before the part of the chapter that explains them. The chapter also describes, but does not illustrate, the reproductive stages of ferns, mosses, and algae.

1. Give some suggestions to help Elaine read and study the chapter.

2. How should she read and study the diagrams in the chapter?

3. What general suggestions would you offer to Elaine to help her succeed in a science course that contains a great deal of technical materials?

Work Sheet 2-3

Make a flow chart that shows the cause and effect of winds of change.
Assessment Sheet 2-1
Vocabulary

Match vocabulary words. (20 points each)

___1. hydroelectricity  a. A building or structure with parts that turn around with wind, used for producing electrical power or crushing grain

___2. windmills  b. Having ideas and plans based on hopes, and that are not reasonable or practical

___3. quixotic  c. Using water power to produce electricity

___4. turbines  d. Able to produce electricity using light

___5. photovoltaic  e. An engine or motor in which the pressure of a liquid or gas moves a special wheel around
Self Evaluation Form

Name:

Score:

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Myself</th>
<th>Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>I learned about the world's energy.</td>
<td>5 4 3 2 1</td>
<td>5 4 3 2 1</td>
</tr>
<tr>
<td>I know how to identify important vocabulary words.</td>
<td>5 4 3 2 1</td>
<td>5 4 3 2 1</td>
</tr>
<tr>
<td>I learned how to understand graphic organizers.</td>
<td>5 4 3 2 1</td>
<td>5 4 3 2 1</td>
</tr>
<tr>
<td>I made myself understood during the discussion.</td>
<td>5 4 3 2 1</td>
<td>5 4 3 2 1</td>
</tr>
<tr>
<td>I know technical reading and writing strategies.</td>
<td>5 4 3 2 1</td>
<td>5 4 3 2 1</td>
</tr>
</tbody>
</table>

5: excellent  
4: good  
3: average  
2: needs improvement  
1: poor

How can I improve my learning?

How can I make myself understood during the discussion?
Lesson Three

Medicine- The Truth About Hormones

Objectives:
1. To develop a general understanding of menopause
2. To develop a general understanding of the facts about hormones
3. To identify terminology and develop skills in dictionary usage
4. To use "summary" reading strategy to summarize the article

Materials:
Focus Sheet 3-1
Focus Sheet 3-2
Focus Sheet 3-3
Work Sheet 3-1
Work Sheet 3-2
Assessment Sheet 3-1
Self Evaluation Form

Warm-up: The teacher asks the students the following question:
Do you know what the advantages and disadvantages of menopause are for your mother?

Task Chain One: To develop a general understanding of menopause
1. The teacher divides students into groups of four.
2. The teacher gives students Focus Sheet 3-1.
3. The teacher asks students to read Focus Sheet 3-1 and summarize what they have read.
4. The teacher asks students to report their understanding of menopause.

Task Chain Two: To develop a general understanding of the facts about hormones
1. The teacher will ask each group to choose a reader, a recorder, a reporter, and a time keeper.
2. The teacher will provide each group with Focus Sheet 3-2 (The Truth about Hormones).
3. The teacher assigns one paragraph to each group.
4. The teacher asks students to read the information and summarize what they have read.
5. The teacher asks students to report their understanding of the truth about hormones.

Task Chain Three: To identify terminology and develop skills in dictionary usage
1. The teacher asks each group to find 10 words they do not understand.
2. The teacher distributes Work Sheet 3-1 to each group.
3. The teacher asks students to write 10 vocabulary words on Work Sheet 3-1 and use the dictionary to check the meaning.
4. The teacher asks each group to assign one student to report their findings to the class.
5. The teacher will give feedback and analysis.

Task Chain Four: To use the “summary” reading strategy to summarize the article
1. The teacher gives students Focus Sheet 3-3.
2. The teacher teaches students the steps to summarize an article.
3. The teacher asks students to work in groups on Work Sheet 3-2.
4. The teacher has groups compare their answers on Work Sheet 3-2.
5. The teacher gives feedback and analysis.

Assessment: The teacher provides students Assessment Sheet 3-1

| 90-100  | Excellent |
| 80-90   | Good     |
| 70-80   | Needs improvement |
| <70     | Study harder |
Focus Sheet 3-1
Menopause

Before Menopause: Many women in their 40s begin to experience a preview of menopause, complete with irregular menses and hot flashes. If the symptoms are severe, some doctors prescribe birth-control pills. Others may still recommend low-dose HRT for a short period of time. Before starting hormones, however, every woman should consider her risk of breast cancer and decide if the benefits of HRT outweigh the drawbacks.

Menopause: HRT remains the most effective treatment for such menopausal miseries as night sweats, hot flashes and mood swings. But women who elect hormone treatment should re-evaluate their decision with their doctor on a yearly basis. Acute menopausal symptoms usually subside after a few years.

After Menopause: Staying on hormones longer than five years no longer appears to be advisable. The risk of breast cancer rises more rapidly for women on HRT after four years, while the dangers of heart disease and blood clots creep upward with each year on hormones. Women who have been on long-term HRT should discuss the risks with their doctor. Weaning gradually from hormones, by lowering the dosage or skipping days, is better than quitting cold turkey.
Susan Pierres, a Miami photojournalist who just turned 60, is confused and angry. Ten years ago, when she was approaching menopause, her doctor started her on hormone-replacement therapy, or HRT. "I didn’t have any symptoms," she recalls, "but he recommended it for general well-being, bones and heart." Many years and pills later, her gynecologist suggested that perhaps it was time to stop. After all, there had been reports that HRT might increase a woman's risk of breast cancer, a disease that had afflicted Pierres' mother and aunt. She turned to several other physicians for advice, they couldn’t seem to agree. Now comes word from a really big study that taking HRT for years at a stretch isn’t such a great idea after all.

Should Pierres believe these latest results or go back to her doctor for an explanation? Which doctor? It’s not as though she’s all that eager to get off hormones: "You feel it’s your last vestige of youth. What if my skin turns scaly and my hair falls out?" she worries. "These are complicated matters. People like me don’t know where to go or whom to listen to."

Whom indeed. For decades, millions of women like Pierres have been told that HRT is a veritable fountain of youth. It kept the skin supple, held back heart disease, boosted old and brittle bones and might even have staved off senile dementia. More than 40% of all women in the U.S. start some form of HRT in their menopause years. Many of them continue well into their 70s and 80s, convinced that the little pills give them a youthful glow.

Like latter-day Ponce de Leόns, however, these women are watching their dream of eternal youth fade away. A large, federally funded clinical trial, part of a group of studies called the Women’s Health Initiative (WHI), had definitively shown for the first time that the hormones in question—estrogen and progestin—are not the age-defying wonder drugs everyone thought they were. As if that weren’t bad enough, the results, made public last week, proved that taking these hormones together for more than a few years actually increases a woman’s risk of developing potentially deadly cardiovascular problems and invasive breast cancer, among other things.
Focus Sheet 3-2 (continued)

As with any major medical announcements, there are caveats and complication. The WHI wasn’t designed to look at short-term use during menopause, for instance. But the principal message is this: taking estrogen and progestin for years in the hope of preventing a heart attack or stroke can no longer be considered a valid medical strategy. Here at last is a rare moment of clarity. The debate over the long-term benefits and risks of HRT has lasted for decades. Now here have at least a few concrete answers. The findings are so striking that the study was stopped three years short of its scheduled completion. (The other WHI trials, which include a look at how estrogen alone affects women with hysterectomies, are still proceeding.) And the formal scientific report, which is being published in this week’s Journal of the American Medical Association, was released a week early at a press conference in Washington.

The phones haven’t stopped ringing since. Women across the U.S. immediately started calling heir doctors, their mothers their daughters, their friends. Are you still taking your pills? Do you think plant-based hormones are any better? Would lowering the dosage make it any safer? “Maybe I’ve been too trusting. I still don’t feel like I have all the facts and details,” says Jodi Simma, 55, a homemaker who engaged nine friends in a spirited discussion over salads and lemon dessert in New Richmond, Wis., last week.

“We’re all concerned,” says Muriel Smith, membership coordinator at the Dave and Mary Alper Jewish Community Center, south of Miami, which is organizing a panel discussion on the topic. “Everyone wants to know what to do.”

Some, like Ellen Robinson, 58, a commercial litigator who works in Chicago, have already made up their minds. Robinson decided last week to stop taking her hormones cold turkey. “I haven’t had breast cancer, a stroke or a heart attack,” she explains, “but now I’m nervous. Everyone had been in the dark about the risks.” Others who were skeptical of hormones all along feel vindicated. “I’m not antiestrogen, but we need to accept menopause as a natural, normal, physiological process,” insists Vicki Meyer, founder of a cybercommunity called the International Organization to Reclaim at menopause.
Focus Sheet 3-2 (continued)

The idea that our bodies fail us at Menopause, she says, is “ludicrous, extremely sexist and just plain wrong.”

Physicians are scrambling to keep up. A gynecologist in Dallas has written a script to help her office staff deal with the deluge of calls. The American College of Obstetrics and Gynecology has created a task force to rethink its guidelines on HRT. “The bubble has burst,” says Dr. Isaac Schiff of the Massachusetts General Hospital in Boston, who is chairing the task force. Schiff admits that in the aftermath of last week’s news, doctors need as much guidance as their patients. “Some physicians say they are not going to change things in their practice at all and will be as proactive for HRT as they’ve ever been,” he says. “Others say this will change their thinking dramatically.”

The Estrogen Express

To understand how we got to this point, it helps to know a little medical history. About 40 years ago, attention was focused on just one female hormone, estrogen. Its greatest popularizer was a gynecologist named Robert Wilson, who thought the hormone could serve as an all purpose rejuvenator for women of a certain age. There was, it must be admitted, more than a little sexism, not to mention ageism, in his point of view. In his hugely successful book, Feminine Forever, published in 1966, Wilson wrote of menopause as a “living decay” in which women descended into a “vapid cow-like” state. Supplemental estrogen, Wilson insisted, would almost magically transform the dull cow into a supple, younger-looking wife and mother. She would not only feel better but also make those around her feel better--especially, it was implied, her partner in bed.

Those were different times, of course. But the idea that a single pill might turn back the clock quickly caught the popular imagination. It didn’t hurt that the hormone’s No. 1 manufacturer, Wyeth Pharmaceuticals, launched and aggressive marketing campaign. Thank goodness today’s spots have been updated to feature the dulcet tones of singer Patti LaBelle and have abandoned patronizing messages like the one in a 1975 ad--“Almost any tranquilizer might calm her down...but at her age, estrogen may be what she really needs.”
Over the years the medical arguments for prescribing estrogen were also updated. "The vapid cowlike state was gone, and there was very scientific language about bone density and heart disease," explains Cynthia Pearson, executive director of the National Women's Health Network, a longtime skeptic of HRT.

It all seemed so logical and convincing. Women are much less likely than men to suffer heart attacks and strokes in their 30s and 40s. But when natural estrogens stop flowing after menopause, women's risk quickly catches up to men's. Clearly estrogen has some kind of positive influence. And sure enough, a number of studies in the 1980s showed that women who took the hormone at menopause had lower levels of LDL cholesterol, than those who didn't. The benefits of supplemental estrogen couldn't be more obvious.

Biology, alas, is rarely so straight forward. Researchers came to realize that it wasn't safe to give estrogen alone to a woman with an intact uterus. Unopposed estrogen, as it is called, dramatically increases the chances that a woman will develop uterine cancer. (Obviously, this isn't a problem for women who have undergone hysterectomies.) The addition of progestin, another female hormone, seemed to take care of that problem.

The conviction that long-term HRT was beneficial became so entrenched that doctors who delved into the issue more closely were surprised to discover how thin the evidence was. In the early 1990s, Dr. Deborah Grady of the University of California at San Diego was asked to help write guidelines on HRT use for the American College of Physicians. She remembers growing increasingly uncomfortable as she sifted through the scientific literature. None of the studies were definitive. Most were observational studies that showed that women who took HRT lived longer and with fewer health problems than those who didn't. Perhaps HRT was the real reason, or perhaps women on HRT were simply more health conscious than their counterparts. No one could say for sure.

Even the studies that showed that estrogen improved a woman's cholesterol profile weren't ultimately all that satisfying. After all, plenty of women with normal cholesterol levels still have heart attacks. What was
Focus Sheet 3-2 (continued)

needed was a hard-core clinical trial so rigorously designed that no one could contest the results.

Former U.S. Congresswoman Pat Schroeder remembers arguing for such studies. At the end of the 1970s, she recalls, the largest study done be the National Institute on Aging “didn’t have one woman in it. They didn’t know anything about osteoporosis, menopause, anything. They wouldn’t do anything for women but throw pills at us.”

With a shove from Schroeder, other female legislators and women’s groups the WHI was launched in 1991. The giant investigation was designed to get some precise answers to the hormone debate and determine the best strategies for preventing the diseases of aging, including heart disease, cancer and osteoporosis.

Some Answer, At Last

More than 160,000 American women are enrolled in the WHI, which is divided into five major studies that look at everything from the role of diet in determine a woman’s health as she ages to the role of hormones in that process. More than 16,000 healthy women, ages 50 to 79, volunteered for the study on estrogen and progestin.

Half of these women were randomly assigned to receive the hormone combination, and the other half were given a placebo, or dummy pill. Neither the women nor their doctors knew who was taking the active medication. This type of study, called a double-blind, randomized, controlled trial, is the most rigorous type of investigation scientists know how to conduct. It’s a long, difficult path to take certain of the results.

The plan was to follow the women for an average of eight years and record how many suffered from heart attacks, strokes, blood clots, hip fractures or colon cancer. From the outset, a safety board monitored the data to ensure that the study would be stopped before its scheduled ending in 2005 if there was evidence of such a clear benefit that it would be unethical to withhold the drug treatment from those women in the control group. It would also be stopped if, conversely, the risks of HRT so obviously outweighed the benefits that women in the treatment group should stop taking the drugs.

The first hint that all was not well came late in 1999, when the monitoring board detected an unexpected increase in the risk of blood clots and heart attacks in
women on combination-hormone therapy. Although the absolute risk was small, it came as a shock. Most doctors believed that hormone replacement offered protection against cardiovascular disease. Investigators informed participants and their doctors of their findings early in 2000 but decided to continue the study to see if the negative effect persisted. Perhaps, they reasoned, it takes longer for cardiovascular benefits to appear.

By the spring of this year, however, a new danger emerged from the data. Not only were women who took estrogen and progestin more likely to suffer heart attacks and blood clots in the lungs and legs, but they also had a slightly increased risk of developing breast cancer. That was just enough to tip the scale. Though the women on HRT suffered fewer hip fractures (1 woman per 1,000 per year vs. 1½ women per 1,000 per year), the benefit wasn’t great enough to warrant the risk. Because the trial was designed to look at women who were already healthy, the safety bar was set fairly high. Given the criteria that the monitoring board had developed before the WHI study began, this part had to be stopped.

Intriguingly, the part of the WHI study that focuses on the long-term benefits of estrogen alone among women who have undergone hysterectomies is ongoing. So far, the safety board has not detected any excess risk of breast cancer in this group. Apparently, estrogen plus progestin has a negative cumulative effect on the breast that estrogen by itself seems not to have.

Some questions still so much for the major conclusions. Now for the caveats and complications. The WHI study looked at the most popular brand of estrogen and progestin, which is called Prempro and is made by Wyeth. Technically speaking, the WHI findings do not apply to other products. Some doctors have speculated that lower-dose hormones or estrogen-progestin patches and creams might somehow avoid some of the risks associated with Prempro. That has yet to be proved. Even so-called natural hormones (those derived from plants) aren’t necessarily risk free. For one thing, they haven’t been as carefully tested as Prempro. There is preliminary laboratory evidence, says Dr. Wulf Utian, who heads the North American Menopause Society, that natural hormones
may promote tissue growth in the breasts and thereby contribute to a cancer risk.

There is also a chance that certain estrogen-like compounds may be developed that will capture all the hormone’s benefits without any of its risks. One such drug, raloxifene, has been shown to prevent fractures, so far without increasing a woman’s risk of breast cancer. But a number of women suffer hot flashes and even blood clots while on raloxifene, making it an unlikely candidate to replace estrogen completely.

Though last week’s news raises big questions for anyone on hormone replacement therapy, women taking birth-control pills shouldn’t panic. True, these pills also contain estrogen and progestin, but most women take them before menopause, when their bodies are making more of their own hormones. So it’s quite possible that their bodies are better able to handle the excess. In any case, it’s impossible to extrapolate from the WHI study.

Nor should women panic if they are using HRT for short-term relief of menopausal miseries. For in a strange sort of way, the study brings HRT back to the basics, doing what it always did best—alleviating intense hot flashes, night sweats and mood swings during the limited period in which they occur. “Estrogens,” says Dr. Howard Judd of UCLA, one of the WHI principal investigators, “are still the best, and in many ways the only, way of treating menopause.”

Is it worth a very slight, short-term risk of blood clots to battle hot flashes? You bet, says Christine Fulbright, 53, who runs her own hair salon in Venice, Calif. Fulbright’s menopausal symptoms, which started a year ago, were so bad she thought she was dying. “I was aching all over and crying all the time,” she recalls. “At one point I was cutting a man’s hair when, out of the blue, I had to fight back tears.” Fulbright tried alternative remedies, like yam creams, but relief came only when she tried Prempro four months ago. “It was like a miracle,” Fulbright says. “I was back to my normal self.”

The tricky part is going to be figuring out just how long women like Fulbright need to stay on HRT, how best to wean them off the treatment and then how to protect them from osteoporosis and other ravages of age without
Focus Sheet 3-2 (continued)

resorting to old-fashioned hormones. "The world of menopause management," says Utian of the North American Menopause Society, "has just become a lot more complex."

And part of that complexity is dealing with the emotional attachment that some women have to their HRT regimen. Many like the way they look and feel on the stuff. Change is scary.

And that, perhaps, is why Susan Pierres, the angry and frustrated Miami photojournalist, has yet to make her move into the wake of last week's news. Along with so many other women, she continues to fret over whether she really has to part with her pills.

Focus Sheet 3-3
Learning Strategy: Summarize

The best way to demonstrate that you understand the information and the ideas in any piece of writing is to compose an accurate and clearly written summary of that piece.

How to write summaries:

♦ Read the passage carefully. Determine its structure. Identify the author’s purpose in writing.
♦ Reread. This time divide the passage into sections or stages of thought. The author’s use of paragraphing will often be a useful guide.
♦ Label, on the passage itself, each section or stage of thought.
♦ Underline key ideas and terms.
♦ Write one-sentence summaries, on a separate sheet of paper, of each stage of thought.
♦ Write a thesis: a one- or two-sentence summary of the entire passage. The thesis should express the central idea of the passage.


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<td>A summary should be:</td>
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<td>► <strong>Concise:</strong> You should include only one statement of the main idea, even if the author repeats it; review only the main points; and, if necessary, include several major details.</td>
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<td>► <strong>Accurate:</strong> You should include all of the main ideas, express them clearly, and reflect the author’s emphasis.</td>
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<td>► <strong>Objective:</strong> You should include only the author’s ideas, not your own opinions, interpretations, and judgments.</td>
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<td>► <strong>Coherent:</strong> You should have smooth transitions, or connections, between sentences.</td>
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After you learn how to summarize, work with your group members to summarize paragraphs 1 through 4. Write four short statements summarizing the meaning of each paragraph. Be prepared to explain your statements.
Assessment Sheet 3-1

Working on your own, summarize paragraphs 5 through 9. Write four short statements summarizing the meaning of each paragraph. (25 points each)
**Self Evaluation Form**

**Name:**

**Score:**

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<th>Myself</th>
<th>Group</th>
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<td>5 4 3 2 1</td>
<td>5 4 3 2 1</td>
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<tr>
<td>I know how to identify important vocabulary.</td>
<td>5 4 3 2 1</td>
<td>5 4 3 2 1</td>
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<td>I learned how to summarize an article.</td>
<td>5 4 3 2 1</td>
<td>5 4 3 2 1</td>
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<td>I made myself understood during the discussion.</td>
<td>5 4 3 2 1</td>
<td>5 4 3 2 1</td>
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<tr>
<td>I know what menopause is.</td>
<td>5 4 3 2 1</td>
<td>5 4 3 2 1</td>
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5: excellent  
4: good  
3: average  
2: needs improvement  
1: poor

How can I improve my learning?

How can I identify important vocabulary?
Lesson Four
Inside the Womb

Objectives:
1. To develop an accurate understanding of how human life begins
2. To learn how to locate the main idea
3. To gain an understanding of scientific terminology

Materials:
Focus Sheet 4-1
Focus Sheet 4-2
Focus Sheet 4-3
Focus Sheet 4-4
Work Sheet 4-1
Work Sheet 4-2
Assessment Sheet 4-1
Self Evaluation Form

Warm-up: The teacher gives students Focus Sheet 4-1.
The teacher asks students the following questions:
1. What do you think of when you see this picture?
2. How long does it take to produce a baby?

Task Chain One: To develop an accurate understanding of how human life begins
1. The teacher divides students in groups of four.
2. The teacher gives students Focus Sheet 4-2.
3. The teacher asks students to read the article.
4. The teacher asks each group to assign one student to summarize the general meaning of the article in his or her own words.

Task Chain Two: To learn how to locate the main idea
1. The teacher gives students Focus Sheet 4-3.
2. The teacher teaches students how to find topic sentences.
3. Students work together to read and underline the topic sentences in each paragraph of Focus Sheet 4-2.
4. The teacher asks students to finish Work Sheet 4-1.
5. The teacher gives feedback and analysis.
Task Chain Three: To gain an understanding of scientific Terminology

1. The teacher gives students Work Sheet 4-2.
2. The teacher asks students to locate unfamiliar words and find their definitions.
3. The teacher gives students Focus Sheet 4-4 for an example.

Assessment: The teacher gives students Assessment Sheet 4-1

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<td>Needs improvement</td>
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<td>&lt;70</td>
<td>Study harder</td>
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Focus Sheet 4-1
Focus Sheet 4-2
Inside the Womb

As the crystal probe slides across her belly, Hilda Manzo, 33, stares wide-eyed at the video monitor mounted on the wall. She can make out a head with a mouth and two eyes. She can see pairs of arms and legs that end in tiny hands and feet. She can see the curve of a backbone, the bridge of a nose. And best of all, she can see movement. The mouth of her child-to-be yawns. Its feet kick. Its hands wave. Dr. Jacques Abramowicz, director of the University of Chicago's ultrasound unit, turns up the audio so Manzo can hear the gush of blood through the umbilical cord and the fast thump, thump, thump of a miniature heart. "Oh, my!" she exclaims as he adjusts the sonic scanner to peer under her fetus' skin. "The heart is on the left side, as it should be" he says, "and it has four chambers. Look-one, two, three, four!"

Such images of life stirring in the womb—in this case, of a 17-week-old fetus no bigger than a newborn kitten—are at the forefront of a biomedical revolution that is rapidly transforming the way we think about the prenatal world. For although it takes nine months to make a baby, we now know that the most important developmental steps—including laying the foundation for such major organs as the heart, lungs and brain occur before the end of the first three. We also know that long before a child is born its genes engage the environment of the womb in an elaborate conversation: a two-way dialogue that involves not only the air its mother breathes and the water she drinks but also what drugs she takes, what diseases she contracts, and what hardships she suffers.

One reason we know this is a series of remarkable advances in MRIs, sonograms and other imaging technologies that allow us to peer into the developmental process at virtually every state from the fusion of sperm and egg to the emergence, some 40 weeks later, of a miniature human being. The extraordinary pictures on these pages come from a new book that captures some of the color and excitement of this research: From Conception to Birth: A Life Unfolds (Doubleday), by photographer Alexander Tsiaras and writer Barry Werth. Their computer-enhanced images are reminiscent of the remarkable fetal portraits taken by medical photographer Lennart Nilsson, which appeared in LIFE magazine in 1965. Like Nilsson's
work, these images will probably spark controversy. Antiabortion activists may interpret them as evidence that a fetus is a viable human being earlier than generally believed, while pro-choice advocates may argue that the new technology allows doctors to detect serious fetal defects at a stage when abortion is a reasonable option.

The other reason we know so much about what goes on inside the womb is the remarkable progress researchers have made in teasing apart the sequence of chemical signals and switches that drive fetal development. Scientists can now describe at the level of individual genes and molecules many of the steps involved in building a human, from the establishment of a head-to-tail growth axis and the budding of limbs to the sculpturing of a four-chambered heart and the weaving together of trillions of neural connections. Scientists are beginning to unroll the genetic blueprint of life and identify the precise molecular tools required for assembly. Human development no longer seems impossibly complex, says Stanford University biologist Matthew Scott. "It just seems marvelous."

How is it, we are invited to wonder, that a fertilized egg a mere speck of protoplasm and DNA encased in a spherical shell can generate such complexity? The answers, while elusive and incomplete, are beginning to come into focus.

Only 20 years ago, most developmental biologists thought that different organisms grew according to different sets of rules, so that understanding how a fly or a worm develops or even a vertebrate like a chicken or a fish would do little to illuminate the process in humans. Then, in the 1980s, researchers found remarkable similarities in the molecular tool kit used by organisms that span the breadth of the animal kingdom, and those similarities have proved serendipitous beyond imagining. No matter what the species, nature uses virtually the same nails and screws, the same hammers and power tools to put an embryo together.

Among the by-products of the torrent of information pouring out of the laboratory are new prospects for treating a broad range of late-in-life diseases. Just last month, for example, three biologists won the Nobel
Focus Sheet 4-2 (continued)

Prize for Medicine for their work on the nematode Caenorhabditis elegans, which has a few more than 1,000 cells, compared with a human’s 50 trillion. The three winners helped establish that a fundamental mechanism that C. elegans embryos employ to get rid of redundant or abnormal cells also exists in humans and may play a role in AIDS, heart disease and cancer. Even more exciting, if considerably more controversial, is the understanding that embryonic cells harbor untapped therapeutic potential.

These cells, of course, are stem cells, and they are the progenitors of more specialized cells that make up organs and tissues. By harnessing their generative powers, medical researchers believe, it may one day be possible to repair the damage wrought by injury and disease. (That prospect suffered a political setback last week when a federal advisory committee recommended that embryos be considered the same as human subjects in clinical trials.)

To be sure, the marvel of an embryo transcends the collection of genes and cells that compose it. For unlike strands of DNA floating in a test tube or stem cells dividing in a Petri dish, an embryo is capable of building not just a protein or a patch of tissue but a living entity in which every cell functions as an integrated part of the whole. “Imagine yourself as the world’s tallest skyscraper, built in nine months and germinating from a single brick,” suggest Tsiaras and Werth in the opening of their book. “As that brick divides, it gives rise to every other type of material needed to construct and operate the finished tower—a million tons of steel, concrete, mortar, insulation, tile, wood, granite, solvents, carpet, cable, pipe and glass as well as all furniture, phone systems heating and cooling units, plumbing, electrical wiring, artwork and computer networks, including software.”

Given the number of steps in the process, it will perhaps forever seem miraculous that life ever comes into being without a major hitch. “Whenever you look from one embryo to another,” observes Columbia University developmental neurobiologist Thomas Jessell, “what strikes you is the fidelity of the process.”

Sometimes, though, that fidelity is compromised, and the reasons why this happens are coming under intense
Focus Sheet 4-2 (continued)

scrutiny. In laboratory organisms, birth defects occur for purely genetic reasons when scientists purposely mutate or knock out specific sequences of DNA to establish their function. But when development goes off track in real life, the cause can often be traced to a lengthening list of external factors that disrupt some aspect of the genetic program. For an embryo does not develop in a vacuum but depends on the environment that surrounds it. When a human embryo is deprived of essential nutrients or exposed to a toxin, such as alcohol, tobacco or crack cocaine, the consequences range from readily apparent abnormalities—spina bifida, fetal alcohol syndrome—to subtler metabolic defects that may not become apparent until much later.

Ironically, even as society at large continues to worry almost obsessively about the genetic origins of disease, the biologists and medical researchers who study development are mounting an impressive case for the role played by the prenatal environment. A growing body of evidence suggests that a number of serious maladies—among them, atherosclerosis, hypertension and diabetes—trace their origins to detrimental prenatal conditions. As New York University Medical School’s Dr. Peter Nathanielsz puts it, “When goes on in the womb before you are born is just as important to who you are as your genes.”

Most adults, not to mention most teenagers, are by now thoroughly familiar with the mechanics of how the sperm in a man’s semen and the egg in a woman’s oviduct connect, and it is at this point that the story of development begins. For the sperm and the egg each contain only 23 chromosomes, half the amount of DNA needed to make a human. Only when the sperm and the egg fuse their chromosomes does the tiny zygote, as a fertilized egg is called, receive its instructions to grow. And grow it does, replicating its DNA each time it divides—into two cells, then four, then eight and so on. If cell division continued in this fashion, then nine months later, the hapless mother would give birth to a tumorous ball of literally astronomical proportions. But instead of endlessly dividing, the zygote’s cells progressively take form. The first striking change is apparent four days after conception, when a 32-cell clump called the morula (which means “mulberry” in Latin) gives
Focus Sheet 4-2 (continued)

rise to two distinct layers wrapped around a fluid-filled core. Now known as a blastocyst, this spherical mass will proceed to burrow into the wall of the uterus. A short time later, the outer layer of cells will begin turning into the placenta and amniotic sac, while the inner layer will become the embryo.

The formation of the blastocyst signals the start of a sequence of changes that as precisely choreographed as a ballet. At the end of Week One, the inner cell layer of the blastocyst balloons into more layers. From the first layer, known as the endoderm, will come the cells that line the gastrointestinal tract. From the second, the ectoderm, will arise the neurons that make up the brain and spinal cord along with the epithelial cells that make up the skin. At the end of Week Two, the ectoderm spins off a thin line of cells known as the primitive streak, which forms a new cell layer called the mesoderm. From it will come the cells destined to make the heart, the lungs and all the other internal organs.

At this point, the embryo resembles a stack of Lilliputian pancakes circular, flat and horizontal. But as the mesoderm forms, it interacts with cells in the ectoderm to trigger yet another transformation. Very soon these cells will roll up to become the neural tube, a rudimentary precursor of the spinal cord and brain. Already the embryo has a distinct cluster of cells at each end, one destined to become the mouth and the other the anus. The embryo, no larger at this point than a grain of rice, has determined the head-to-tail axis along which all its body parts will be arrayed.

How on earth does this little, barely animate cluster of cell "know" what to do? The answer is as simple as it is startling. A human embryo knows how to lay out its body axis in the same way that fruit-fly embryos know and C. elegans embryos and the embryos of myriad other creatures large and small know. In all cases, scientists have found, in charge of establishing this axis is a special set of genes, especially the so-called homeotic homeobox, or HOX, genes.

HOX genes were first discovered in fruit flies in the early 1980s when scientists noticed that their absence caused striking mutations. Heads, for example, grew feet instead of antennae, and thoraxes grew an extra
pair of wing, HOX genes have been found in virtually every type of animal, and while their number varies fruit flies have nine, human have 39 they are invariably arrayed along chromosomes in the order along the body in which they are supposed to turn on.

Many other genes interact with the HOX system, including the aptly named Hedgehog and Tinman genes, without which fruit flies grow a dense covering of bristles or fail to make a heart. And scientists are learning in exquisite detail what each does at various stages of the developmental process. Thus one of the three Hedgehog genes Sonic Hedgehog, named in honor of the cartoon and video-game character had been shown to play a role in making at least half a dozen types of spinal-cord neurons.

As it happens, cells in different places in the neural tube are exposed to different levels of protein encoded by this gene; cells drenched in significant quantities of protein mature into one type of neuron, and those that receive the barest sprinkling mature into another. Indeed, it was by using a particular concentration of Sonic Hedgehog that neurobiologist Jessell and his research team at Columbia recently coaxed stem cells from a mouse embryo to mature into seemingly functional motor neurons.

At the University of California, San Francisco, a team led by biologist Didier Stainier is working on genes important in cardiovascular formation. Removing one of them, called Miles Apart, from zebra-fish embryos results in a mutant with two nonviable hearts. Why? In all vertebrate embryos, including humans, the heart forms as twin buds. In order to function, these buds must join. The way the Miles Apart gene appears to work, says Stainier, is by detecting a chemical attractant that, like the smell of dinner cooking in the kitchen, entices the pieces to move toward each other.

The crafting of a human from a single fertilized egg is a vastly complicated affair, and at any step, something can go wrong. When the heart fails to develop properly, a baby can be born with a hole in the heart or even missing valves and chambers. When the neural tube fails to develop properly, a baby can be born with a brain not fully developed (anencephaly) or with an
incompletely formed spine (spina bifida). Neural tube defects, it has been firmly established, are often due to insufficient levels of the water-soluble B vitamin folic acid. Reason: folic acid is essential to a dividing cell’s ability to replicate its DNA.

Vitamin A, which a developing embryo turns into retinoids, is another nutrient that is critical to the nervous system. But watch out, because too much vitamin A can be toxic. In another newly released book Before Your Pregnancy (Ballantine Books), nutritionist Amy Ogle and obstetrician Dr. Lisa Mazzullo caution would-be mothers to limit foods that are overly rich in Vitamin A, especially liver and food products that contain lots of it, like foie gras and cod-liver oil. An excess of vitamin A, they note, can cause damage to the skull, eyes, brain and spinal cord of a developing fetus, probably because retinoids directly interact with DNA, affecting the activity of critical genes.

Folic acid, vitamin A and other nutrients reach developing embryos and fetuses by crossing the placenta, the remarkable temporary organ produced by the blastocyst that develop from the fertilized egg. The outer ring of cells that composed the placenta are extremely aggressive, behaving very much like tumor cells as they invade the uterine wall and tap into the pregnant woman’s blood vessels. In fact, these cells actually go in and replace the maternal cells that form the lining of the uterine arteries, says Susan Fisher, a developmental biologist at the University of California, San Francisco. They trick the pregnant woman’s immune system into tolerating the embryo’s presence rather than rejecting it like the lump of foreign tissue it is.

In essence, says Fisher, “The placenta is a traffic cop,” and its main job is to let good things in and keep bad things out. To this end, the placenta marshals platoons of natural killer cells to patrol its perimeters and engages millions of tiny molecular pumps that expel poisons before they can damage the vulnerable embryo.

Alas, the placenta’s defenses are sometimes breached—by microbes like rubella and cytomegalovirus, by drugs like thalidomide and alcohol, by heavy metals like lead and mercury, and by organic pollutants like dioxin and PCBS. Pathogens and poisons contained in
certain foods are also able to cross the placenta, which may explain why placental tissues secrete a nausea-inducing hormone that has been tentatively linked to morning sickness. One provocative if unproved hypothesis says morning sickness may simply be nature’s crude way of making sure that potentially harmful substances do not reach the womb, particularly during the critical first trimester of development.

Timing is decisive where toxins are concerned. Air pollutants like carbon monoxide and ozone, for example, have been linked to heart defects when exposure coincided with the second month of pregnancy, the window of time during which the heart forms. Similarly, the nervous system is particularly vulnerable to damage while neurons are migrating from the part of the brain where they are made to the area where they will ultimately reside. “A tiny, tiny exposure at a key moment when a certain process is beginning to unfold can have an effect that is not only quantitatively larger but qualitatively different than it would be on an adult whose body has finished forming,” observes Sandra Steingraber, an ecologist at Cornell University.

Among the substances Steingraber is most worried about are environmentally persistent neurotoxins like mercury and lead (which directly interfere with the migrating of neurons formed during the first trimester) and PCBS (which, some evidence suggests, blocks the activity of thyroid hormone). “Thyroid hormone plays a noble role in the fetus,” says Steingraber. “it actually goes into the fetal brain and serves as kind of a conductor of the orchestra.”

PCBS are no longer manufactured in the U.S., but other chemicals potentially harmful to the developing embryos and fetuses are. Theo Colborn, director of the World Wildlife Fund’s contaminants program, says at least 150 chemicals pose possible risks for fetal development, and some of them can interfere with the naturally occurring sex hormones critical to the development of a fetus. Antiandrogens, for example, are widely found in fungicides and plastics. One in particular DDE, a breakdown product of DDT has been shown to cause hypospadias in laboratory mice, a birth defect in which the urethra fails to extend to the end of the penis. In
Focus Sheet 4-2 (continued)

humans, however, notes Dr. Allen Wilcox, editor of the journal Epidemiology, the link between hormone-like chemicals and birth defects remains elusive.

The list of potential threats to embryonic life is long. It includes not only what the mother eats, drinks or inhales, explains N.Y.U.’s Nathanielsz, but also the hormones that surge through her body. Pregnant rats with high blood-glucose levels (chemically induced by wiping out their insulin) give birth to female offspring that are unusually susceptible to developing gestational diabetes. These daughter rats are able to produce enough insulin to keep their blood glucose in check, says Nathanielsz, but only until they become pregnant. At that point, their glucose level soars, because their pancreases were soated in mother’s sugar-spiked blood. The next generation of daughters is, in turn, more susceptible to gestational diabetes, and the transgenerational chain goes on.

In similar fashion, atherosclerosis may sometimes develop because of prenatal exposure to chronically high cholesterol levels. According to Dr. Wulf Palinski, an endocrinologist at the University of “California at San Diego, there appears to be a kind of metabolic memory prenatal life that is permanently retained. In genetically similar groups of rabbits and kittens, at least, those born to mothers on fatty diets were far more likely to develop arterial plaques than those whose mothers ate lean.

But of all the long-term health threats, maternal undernourishment which stunts growth even when babies are born full term may top the list. “People who are small at birth have, for life, fewer kidney cells, and so they are more likely to go into renal failure when they get sick,” observes Dr. David Barker, director of the environmental epidemiology unit at England’s University of Southampton. The same is true of insulin-producing cells in the pancreas, so that low-birth-weight babies stand a higher chance of developing diabetes later in life because their pancreases where insulin is produced have to work that much harder. Barker, whose research has linked low birth weight to heart disease, points out that undernourishment can trigger lifelong metabolic changes. In adulthood, for example, obesity may become a problem because food
Focus Sheet 4-2 (continued)

scarcity in prenatal life causes the body to shift the rate at which calories are turned into glucose for immediate use or stored as reservoirs of fat.

But just how does undernourishment reprogram metabolism? Does it perhaps prevent certain genes from turning on, or does it turn on those that should stay silent? Scientists are racing to answer those questions, along with a host of others. If they succeed, many more infants will find safe passage through the critical first months of prenatal development. In deed, our expanding knowledge about the interplay between genes and the prenatal environment if cause for both concern and hope. Concern because maternal and prenatal health care often ranks last on the political agenda. Hope because by changing our priorities, we might be able to reduce the incidence of both birth defects and serious adult diseases.

Focus Sheet 4-3
Strategy for Finding Topic Sentence

Where to find the topic sentence?

Although the topic sentence of a paragraph can be located anywhere in the paragraph, there are several positions where it is most likely to be found.

♦ First sentence: the most common placement of the topic sentence is first in the paragraph. The author states the main idea at the beginning and then elaborates on it.

♦ Last sentence: The second most common position of topic sentence is last in the paragraph. In this type of paragraph, the author leads or builds up to the main idea and states it in a sentence at the very end.

♦ Middle of the paragraph: Another common placement of the topic sentences is in the middle of the paragraph. In this case, the author builds up to the main idea, states it in the middle, and then goes on with further elaboration and detail.

♦ First and last sentences: The writer states the main idea at the beginning of the paragraph, then explains or supports the idea, and finally restates the main idea at the very end.

### Focus Sheet 4-4
#### Terminology

<table>
<thead>
<tr>
<th>New Words</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ultrasound</td>
<td>Sound that is too high for humans to hear, and is often used in medical processes</td>
</tr>
<tr>
<td>umbilical cord</td>
<td>A long narrow tube of flesh that joins an unborn baby to its mother</td>
</tr>
<tr>
<td>vertebrate</td>
<td>A living creature that has a backbone</td>
</tr>
<tr>
<td>nematode</td>
<td>A type of small worm that can destroy crops</td>
</tr>
<tr>
<td>embryo</td>
<td>An animal or human that has not yet been born, and has just begun to develop</td>
</tr>
</tbody>
</table>
Work Sheet 4-1
Topic Sentences

Working on your own, write down the topic sentences and the main ideas in paragraphs one through three.

Paragraph One
Topic Sentence:

Main Idea:

Paragraph Two
Topic Sentence:

Main Idea:

Paragraph Three
Topic Sentence:

Main Idea:
### Work Sheet 4-2

**Terminology**

<table>
<thead>
<tr>
<th>New Words</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ultrasound</td>
<td></td>
</tr>
<tr>
<td>umbilical</td>
<td></td>
</tr>
<tr>
<td>vertebrate</td>
<td></td>
</tr>
<tr>
<td>nematode</td>
<td></td>
</tr>
<tr>
<td>embryo</td>
<td></td>
</tr>
</tbody>
</table>
Assessment Sheet 4-1

Working on your own, find ten scientific terms from Focus Sheet 4-2 and write their definitions. (10 points each)

<table>
<thead>
<tr>
<th>Terminology</th>
<th>Definition</th>
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</thead>
<tbody>
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</tbody>
</table>
**Self Evaluation Form**

Name: 

Score: 

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Myself</th>
<th>Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>I learned about how human life begins.</td>
<td>5 4 3 2 1</td>
<td>5 4 3 2 1</td>
</tr>
<tr>
<td>I know how to find the main idea.</td>
<td>5 4 3 2 1</td>
<td>5 4 3 2 1</td>
</tr>
<tr>
<td>I learned how to understand the terminology.</td>
<td>5 4 3 2 1</td>
<td>5 4 3 2 1</td>
</tr>
<tr>
<td>I made myself understood during the discussion.</td>
<td>5 4 3 2 1</td>
<td>5 4 3 2 1</td>
</tr>
<tr>
<td>I know how to find the topic sentences.</td>
<td>5 4 3 2 1</td>
<td>5 4 3 2 1</td>
</tr>
</tbody>
</table>

5: excellent  
4: good  
3: average  
2: needs improvement  
1: poor

How can I improve my learning?

How can I find the topic sentences?
Lesson Five
An Introduction to Psychology and Psychologists

Objectives:
1. To be able to identify specialized vocabulary words in a paragraph
2. To increase reading comprehension skills in students
3. To be able to interpret the information about the article, An Introduction to Psychology and Psychologists

Materials:
Focus Sheet 5-1
Work Sheet 5-1
Work Sheet 5-2
Work Sheet 5-3
Assessment Sheet 5-1
Self Evaluation Form

Warm-up: The instructor will ask students the following questions:
1. Do you know what behavior is?
2. What information will be found in the chapter?
   The teacher tells students that they will read an article about psychology.

Task Chain One: To be able to identify specialized vocabulary words in a paragraph
1. The teacher writes the following vocabulary words from the article, An Introduction to Psychology and Psychologists, on the board. The teacher divides students in groups of four.
2. The teacher gives the article to students (Focus Sheet 5-1). The teacher tells students to find the vocabulary words in the article, and to underline them.
3. The teacher assigns one paragraph of the article to each group. The teacher tells students to read the article paying particular attention to the vocabulary words they underlined.
4. The teacher will provide students with Work Sheet 5-1.
5. Students complete Work Sheet 5-1 in their group.
Task Chain Two: To increase reading comprehension skills in students

1. The teacher tells students that when they read, they must find one topic for each paragraph in order to comprehend what they are reading.
2. The teacher shows on the overhead Work Sheet 5-2 (Topic Sentences). The teacher explains to students that they must find the topic sentence related to the paragraph they read. The teacher tells students that they will need to cut this particular sentence from Work Sheet 5-2 and match it to their paragraph.
3. At the end of the activity, students will read sentence they cut and re-read the paragraph to the class to see if their paragraphs match with the sentence.
4. The teacher has students go back to their group.
5. The teacher uses the overhead and puts Focus Sheet 5-1. The teacher then uses Work Sheet 5-2 and correctly matches each topic sentence with the paragraph.
6. The teacher lets students know that finding the topic sentence in a paragraph, will help them in comprehend the story.

Task Chain Three: To be able to interpret the information about the article, An Introduction to Psychology and Psychologists

1. The teacher will divide students in groups of four.
2. The teacher will ask each group to choose a reader, a recorder, a reporter and a time keeper.
3. The teacher gives each group Work Sheet 5-3.
4. Students discuss the information in their group. Students answer the questions together.

Assessment: The teacher provides students with Assessment Sheet 5-1.

<table>
<thead>
<tr>
<th>Score Range</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>90-100</td>
<td>Excellent</td>
</tr>
<tr>
<td>80-90</td>
<td>Good</td>
</tr>
<tr>
<td>70-80</td>
<td>Needs improvement</td>
</tr>
<tr>
<td>&lt;70</td>
<td>Study harder</td>
</tr>
</tbody>
</table>
Focus Sheet 5-1

An Introduction to Psychology and Psychologists

Why Study Psychology?

You are a universe, a collection of worlds within worlds. Your brain is possibly the most complicated and amazing device in existence. Through the action of its 14 billion cells you are capable of art, music, science, philosophy, and war. Your capacities for compassion, affection, and dedication coexist with your capacities for aggression, hatred, and ... murder? You are the most frustrating riddle ever written, a mystery at times even to yourself. You are at one and the same time a unique event in human history and like everyone who has ever lived. Your thoughts, emotions, and actions, your behavior and conscious experience, are the subject of this book.

Perhaps the simplest reason for studying psychology is that we are in the midst of a psychological revolution. Aldous Huxley has said:

We have had religious revolutions, we have had political, industrial, economic, and nationalistic revolutions. All of them, as our descendents will discover, were but ripples in an ocean of conservatism - trivial by comparison with the psychological revolution toward which we are rapidly moving (Huxley, 1971).

Look around you. Newspapers, magazines, radio, and television abound with psychological information. Psychology is discussed in homes, schools, businesses, and bars. Psychology is an explosive, exciting, and ever-changing panorama of people and ideas. You can hardly consider yourself "educated" without knowing something about it.

There is another reason for studying psychology. Socrates said, "Know thyself," and although we must envy those who have set foot on the moon, looked into an atom, or experienced firsthand the dreamlike landscapes of the ocean's depths, the ultimate frontier still lies close to home. Psychologist D. O. Hebb puts it this way: "What is psychology all about? ... Psychology is about the mind: the central issue, the great mystery, the toughest problem of all" (Hebb, 1974).
Focus Sheet 5-1 (continued)

Psychology is a journey into inner space. This book is a travel guide. Psychologists can’t claim to have “the answers” to all of your questions, but they can show you the contours of the landscape already explored. More importantly, you may find skills in psychology that will aid you in your own search for answers. Ultimately the answers must be your own, but the study of psychology is a rich starting point. In this chapter you will find a definition of psychology, a description of various kinds of psychologist and what they do, and a brief history of ideas in psychology.

Question: What is psychology?

It is important then, to be open-minded as you begin the study of psychology. Consider it an adventure, and judge after you have seen what psychology has to offer. For now, let us say that psychology is the scientific study of the behavior of organisms. Its goals are to describe, understand, predict, and control behavior.

Question: What does “behavior” refer to in the definition of psychology?

Behavior is anything you do. Eating, sleeping, talking, thinking, and sneezing are “behaviors.” So are dreaming, gambling, taking drugs, watching TV, learning Spanish, basket weaving, and reading this book. Psychologists prefer to focus on behavior because it can be observed and measured. Psychology floundered early in its development because psychologist differed in their answers to questions such as: “When you look at a green lawn, do you experience the same color sensation that I do?” This question can’t be answered. It is too subjective. You may experience the sensation I call “red,” but if we both consistently label it “green” (because it happens every time we look at the lawn) we will never discover that we have had different experiences. All we can observe scientifically, or empirically, is that when we look at the same stimulus (the lawn) we respond alike: We call it “green.”
Focus Sheet 5-1 (continued)

Question: Then psychologists try to be objective?

Yes. Psychologists have a special respect for empirical evidence. That is, information gained by direct observation and measurement, rather than through opinion, argument, or reliance on authority. Would you say it’s true that “you can’t teach an old dog new tricks”? Why argue about it? A psychologist would get ten “new” dogs, ten “used” dogs, and then ten “old” dogs and then try to teach them all new tricks to find out!

Whenever possible, psychologists settle differences by direct investigation. As self-evident as this approach may seem in fields such as biology or physics, we are still often tempted in psychology to accept what seems plausible or sensible, rather than what is.

For example, see how many of these questions you can answer correctly on the basis of personal experience, reasoning, or common sense, and then we will compare your answers to those established empirically.

1. Owls can see in completely darkness. T or F?
2. The higher a person’s intelligence, the greater the chance of mental illness. (Genius is next to insanity.) T or F?
3. The image of the moon is magnified by the atmosphere near the horizon. T or F?
4. Those who threaten suicide rarely actually commit suicide. T or F?
5. Through the use of hypnosis, people can be made to perform unusual feats of strength. T or F?
6. Intelligence is completely inherited from one’s parents. T or F?
7. If your car breaks down, you are more likely to get help from a passerby on a busy high way than on a lightly traveled country road. T or F?
8. Punishment is the most effective way to reinforce the learning of new habits. T or F?
9. Drug addiction is one of the major causes of murder and other violent crimes. T or F?
10. A one-eyed man could not land an airplane. T or F?

Scoring this quiz is easy since all of the statements are F, false. If you missed some, don’t despair, because the point is simply this: Psychology became a science when
Focus Sheet 5-1 (continued)

psychologists began to perform experiments, make observations, and seek evidence, and you will become a more critical and sophisticated observer of human behavior to the extent that you do the same.

Question: I’ve heard that psychology isn’t scientific. You have said it is. Is it?

Psychology has been described by some as the “almost science” because scientific study of humans is not yet possible in all areas of research. Sometimes questions go unanswered because of moral or practical limitations. What would happen if a child were placed in a soundproof, lightproof box for the first five years of life? This question will probably never be directed answered. (However, many times an indirect answer can be obtained by studying animals.) Sometimes research must await a receptive social climate. Very little was known about human sexual response until William Masters, a gynecologist, and Virginia Masters, a psychologist, pioneered direct recording of physiological responses to sexual intercourse. Such research would have been impossible to carry out and publish 20 years ago.

More frequently, psychological questions remain unanswered because a suitable method does not yet exist. For years the subjective reports of people who said they never dream had to be considered accurate. Then the EEG (electroencephalograph or brain-wave machine) was developed, and it became possible to tell objectively when a person is dreaming. People who “never dream,” it turns out, dream frequently and remember their dreams when awakened during one. Through use of the EEG, the study of dreaming is becoming quite scientific.

## Work Sheet 5-1
### Understanding Vocabulary

Write the definition of each word.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>1.</td>
<td>cells</td>
</tr>
<tr>
<td>2.</td>
<td>philosophy</td>
</tr>
<tr>
<td>3.</td>
<td>hypnosis</td>
</tr>
<tr>
<td>4.</td>
<td>atmosphere</td>
</tr>
<tr>
<td>5.</td>
<td>genius</td>
</tr>
<tr>
<td>6.</td>
<td>owls</td>
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<tr>
<td>7.</td>
<td>gynecologist</td>
</tr>
<tr>
<td>8.</td>
<td>pioneered</td>
</tr>
<tr>
<td>9.</td>
<td>economic</td>
</tr>
<tr>
<td>10.</td>
<td>conservatism</td>
</tr>
<tr>
<td>Topic Sentence</td>
<td>The definition of behavior</td>
</tr>
<tr>
<td>----------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>Topic Sentence</td>
<td>The reason to study psychology</td>
</tr>
<tr>
<td>Topic Sentence</td>
<td>How can one describe psychology?</td>
</tr>
<tr>
<td>Topic Sentence</td>
<td>The definition of psychology</td>
</tr>
<tr>
<td>Topic Sentence</td>
<td>Do psychologists try to be objective?</td>
</tr>
</tbody>
</table>
Give brief answers to the following questions.

1. How is psychology defined in this article?

2. What is behavior?

3. What is empirical evidence?

4. What are some limitations on psychological research?
Answer the following statements True or False. (10 points each)

___1. Psychology is a subjective field of study.

___2. Many psychological questions go unanswered because a suitable method does not yet exist.

___3. We now have machinery that can tell us objectively when a person is dreaming.

___4. Psychologists can find answers to questions about humans indirectly by studying animals.

___5. Direct investigation is an approach used in biology and physics but not in psychology.

___6. Eating, watching TV, and taking drugs are all examples of human behavior.

___7. There are no limitations for a psychologist engaged in research.

___8. Psychological research about human sexual response began over fifty years ago.

___9. Psychologists find answers only by accepting what seems sensible to them.

Self Evaluation Form

Name:

Score:

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Myself</th>
<th>Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>I learned about psychology.</td>
<td>5 4 3 2 1</td>
<td>5 4 3 2 1</td>
</tr>
<tr>
<td>I know how to identify specialized vocabulary.</td>
<td>5 4 3 2 1</td>
<td>5 4 3 2 1</td>
</tr>
<tr>
<td>I learned how to increase reading comprehension.</td>
<td>5 4 3 2 1</td>
<td>5 4 3 2 1</td>
</tr>
<tr>
<td>I made myself understood during the discussion.</td>
<td>5 4 3 2 1</td>
<td>5 4 3 2 1</td>
</tr>
<tr>
<td>I know how to interpret the information in the article.</td>
<td>5 4 3 2 1</td>
<td>5 4 3 2 1</td>
</tr>
</tbody>
</table>

5: excellent
4: good
3: average
2: needs improvement
1: poor

How can I improve my learning?

How can I make myself understood during the discussion?
Lesson Six
Man--The Bridge Builder

Objectives:
1. To know how to identify specialized vocabulary
2. To know how to read figures
3. To read an article to obtain the most important information

Materials:
Focus Sheet 6-1
Focus Sheet 6-2
Work Sheet 6-1
Work Sheet 6-2
Work Sheet 6-3
Work Sheet 6-4
Assessment Sheet 6-1
Self Evaluation Form

Warm-up: The teacher elicits students' prior knowledge and students' imagination by asking the following question:
In designing a bridge, an engineer must be very careful to design it so that it does not collapse. What are some of things that the engineer must consider?

Task Chain One: To know how to identify specialized vocabulary
1. The teacher writes the specialized vocabulary from the article, Man--The Bridge Builder, on the board. The teacher divides students in groups of four.
2. The teacher gives the article to students (Focus Sheet 6-1). The teacher tells students to find the vocabulary words in the article, and to underline them.
3. The teacher assigns one paragraph of the article to each group. The teacher tells students to read the article paying particular attention to the vocabulary words they underlined.
4. The teacher will provide students with Work Sheet 6-1.
5. Students complete Work Sheet 6-1 in their group.
Task Chain Two: To know how to read figures
1. The teacher provides students Focus Sheet 6-2.
2. The teacher teaches students how to read figures.
3. The teacher gives students Work Sheet 6-2.
4. The teacher asks students work in groups of four to finish Work Sheet 6-2.
5. The teacher will give feedback and analysis.

Task Chain Three: To read an article to obtain the most important information
1. The teacher divides students in groups of four.
2. The teacher has students reading the article. The teacher asks students to read the sentences of Work Sheet 6-3 and to answer them.
3. After students finishing reading, the teacher provides students with Work Sheet 6-4.
4. The teacher asks students to work in groups of four to answer the questions.
5. The teacher asks each group to report to the class an important point about the article.

Assessment: The teacher will give students Assessment Sheet 6-1

| 90-100 | Excellent |
| 80-90  | Good      |
| 70-80  | Needs improvement |
| <70    | Study harder |
I. Introduction

Bridges, like everything else made and used by man, have a history. The history of bridges is inseparable from the history of other activities of man. He has been a complex interaction among all the activities of man as he evolved through the ages. This interaction and evolution are probably as important to his activities as a bridge builder as to any other activity. The history of man and his bridges has its beginnings in the prehistoric era. As a result we can only make educated guesses as to how man the hunter food gatherer discovered, used, and eventually imitated those bridges that nature made available.

In this study of bridges we shall carefully examine how a bridge supports the loads we place on it. Any bridge is created to support the weight of people and their animals or vehicles over an opening. This weight represents a force acting down on the bridge, and it is balanced by forces acting up at the points where the bridge is supported. Just how the bridge accomplishes this task is the major concern of this chapter.

Figure 2.1

There are four distinctly different bridge forms: the beam, the arch, the suspension, and the truss. Of these, the first three can be found in nature. The beam, the arch, and the suspension bridge all have their beginnings in naturally occurring situations, which were available to primitive man for his use.

The beam-type bridge can be seen wherever a tree has fallen across a stream. Primitive man surely used such
tree bridges to cross rivers that were too deep to ford. The location of the fallen tree may not have been very convenient for him, which meant he had to go out of his way to get from one place to another. When early man had acquired the use of cutting tools and developed some of the impatience of modern man, he built his bridges where he wanted them by cutting or burning down a tree. Figure 2.1 is an example of his crude bridge form. Until that time he simply looked for a bridge or remembered where one was located and used it.

The simple beam bridge made of a crude log was only the beginning of this beam form. As man’s reasoning powers expanded, he learned that by placing piles of stones in a stream he could span wider streams. Shorter logs, or even a crude flat stone, could be made to reach from one pile to another in succession, making a multiple-span beam bridge. There are other types of beam bridges that differ from the simple beam only in the manner in which they are supported. The distinction between simple beams and other types of beams will be made clear later in this chapter.

Many of the so-called natural arch bridges that are so spectacular are not really arches at all. The openings give the appearance of arches, but the material spanning the opening acts much like a beam. The archlike openings were probably caused by the erosion of soft material from beneath a more durable material. The result of this erosion can result in huge dramatic structures such as those found in the western part of the United States. Erosion may also cause the formation of a simple cave. The cave that provided shelter for primitive man is closer to the true arch than its more dramatic counterpart in nature.

A nature arch can also be formed as the result of a rock slide that occurs in such a way that rocks are piled over a stream bed, as illustrated in Figure 2.2. The rocks may wedge together tightly enough to provide a reasonably strong arch.
Just how man accomplished his first true arch bridge is not known. As early as 4000 B.C. the people of Mesopotamia were using the true arch, or vault. Certainly these were preceded by many attempts to imitate the inspiring arch shapes in nature.

Suspension bridges had their beginnings in the tropical climates where vines grow to enormous lengths. A suspension bridge today is not fundamentally different from the crude system developed by early man. All modern man has done is making his suspension bridges longer, stronger, and more comfortable.

The first use of the vine to cross a river was most likely accomplished by swinging from one bank to another. Unfortunately, once he arrived on the other side of the river and let go of the vine, the man lost his means of transportation back. It was not long before some bright person thought to tie his vine to a tree and have it there when he came back to recross the river. The next thing to occur to him was that by securing each end of a vine to a tree on each bank of the river he could get himself back and forth quite safely by a hand-over-hand technique. This finally was the fundamental form of the suspension bridge.
By placing two vines parallel to each other and spanning the opening between them with short beams of small branches, early man was able to improve the suspension bridge by providing a floor. This was further improved by attaching two more vines above the floor level to provide sides for the bridge, as shown in Figure 2.3. Each improvement to the suspension bridge would seem to be in a direct evolutionary line to the modern version of this exciting bridge form.

The fourth bridge form, the truss, came into being much later in man’s history. The gable or trussed roof had been used for some time earlier, but it was not until the Renaissance that the principle of the truss was understood and used extensively.

This brief description of the early interaction of man and bridges is, of course, highly speculative. The details and the time involved in the evolution of these bridge forms are obscure. However, the facts are that prehistoric man did use, and eventually imitated, the bridge forms found in nature, and these are the fundamental forms that modern man uses today.

II. Forces and Equilibrium

The bridge as a structure is subjected to the push and pull of forces. The loads imposed on the bridge by the man, animal, or vehicle using the bridge and the weight of the bridge itself are forces that ultimately push down on the points where the bridge is supported. These points, known generally as piers or abutments, provide for forces that push up on the bridge to balance the forces pushing down. Assuming that the bridge does not break under the loads, we can say that the bridge is in equilibrium. The notions of force and equilibrium are important to the understanding of how the four bridge forms work.

A force is felt by the human body in terms of effort expended to push or pull an object. A more useful definition of force is that it is a magnitude (pounds) and a direction, that is, a line of action in space. The force may be represented graphically by an arrow, the length being proportional to the magnitude and the arrowhead pointing in the proper direction along the line of action.
We shall concern ourselves with a very restricted system of forces in our discussion, namely, forces acting in one plane only. If a group of forces is restricted to acting in a plane (obviously the plane containing the bridge), it is called a coplanar force system.

Equilibrium implies balance. Balance may be illustrated by the action of two people on a seesaw, as shown in Figure 2.4. If one of the people weighs more than the other, he must sit in a different distance from the balance point in order that the two people balance each other. When this happens, we say that the moments of the forces (the weight of the person times his distance from the balance point) about the balance point is algebraically zero. The person on the left exerts a counterclockwise moment about the balance point, while the person on the right exerts a clockwise moment. Assuming that the plank (a beam?) does not break, the two people have achieved equilibrium.

One other condition must be satisfied in order to completely assure equilibrium. The pipe that furnishes the balance point must be strong enough to provide an upward force equal to the combined weights of the two people. In other words, the algebraic sum of the forces acting on the plank must be zero.

Our seesaw involves only forces in the vertical direction. We must consider one more possibility to describe the requirements of equilibrium of forces in a plane, that is, the possibility of horizontal forces acting in the plane. In a real bridge, horizontal forces may be exerted by the action of vehicles as they start and stop on the bridge roadway. In the cases of the arch
and suspension forms, as well shall see later, the structure itself exerts horizontal forces on the foundations.

The nature of forces is such that their total effect on a bridge may be separated into vertical and horizontal effects. We do this by breaking the force into two components, one with a horizontal orientation and one with a vertical orientation. Actually, forces may be broken up into any pair of components associated with directions other than vertical and horizontal, but these are the most convenient for our purposes.

Focus Sheet 6-2
Strategies

Tables and Figures

Textbooks often use diagrams, charts, and tables along with the written text to clarify an abstract idea or to present evidence from research. The text and these graphics are interrelated. Therefore, understanding the text will help you to understand the chart or table; also the chart or table will help you to visualize what is written in the text.

When looking at a specific table or graph, always note the title, the headings for each column, the information presented vertically, and the information presented horizontally. Note the source (where the table comes from) and any footnotes. Note the unit of measurement or scale. (For example, sometimes the number 1 can stand for 100.) Decide what is being compared and finally how the information is related to the reading passage.

Write the definition of each word.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>1. vehicle</td>
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<td>2. cave</td>
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<tr>
<td>3. vine</td>
<td></td>
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<td>4. branches</td>
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<td>5. Renaissance</td>
<td></td>
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<tr>
<td>6. algebraically zero</td>
<td></td>
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<tr>
<td>7. beam</td>
<td></td>
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<tr>
<td>8. suspension</td>
<td></td>
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<tr>
<td>9. truss</td>
<td></td>
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<tr>
<td>10. equilibrium</td>
<td></td>
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</tbody>
</table>
Work Sheet 6-2
Figure: Equilibrium

Look at figure and answer the questions. The two people are sitting on what is called in English a seesaw. If you have ever sat on one, you will easily understand the figure.

1. What is the title of this figure?
2. The word element _equi_ means equal. Therefore, what do you think this figure illustrates?
3. The latter _F_ in this figure means force; in this case it represents the weights of the two people on the board. They are pushing down with a combined force of _F_1+ _F_2. What is pushing up with an equal force?
4. In this figure, _d_ represents the distance each person is sitting from the center of the seesaw. You will learn in the reading that _F_1 xd_1 must equal _F_2 xd_2 for the two people on the right, must the person on the left sit closer to or farther from the center than the person on the right?
Mark each statement True or False.

___ 1. The purpose of a bridge is to support weight over an opening.

___ 2. A log fallen across a stream is a natural arch type of bridge.

___ 3. Erosion of soft material caused true arch bridges.

___ 4. Approximately 6,000 years ago people made true arches.

___ 5. Crossing a river with a vine was probably the first use of a suspension bridge.

___ 6. A floor on a suspension bridge was made from small pieces of wood.

___ 7. The truss type of bridge has been used for perhaps a thousand years.

___ 8. A bridge is in equilibrium if the forces pushing up equal those pushing down.

___ 9. Piers and abutments balance the forces pushing down on a bridge.

___ 10. It is possible that cars starting and stopping on a bridge cause vertical forces.
Match the items on the right with the correct type or types of bridge on the left. Notice that the last choice is for items that are true all bridge types. The first one is done for you.

Example: a,____ 1. Beam  a. Can be found in nature
a,____ 2. Arch  b. A tree across a stream
a,____ 3. Suspension  c. Must have equilibrium
_____ 4. Truss  d. Vines were first used for this type
_____ 5. All types  e. Several logs or a flat stone on piles of rocks
                   f. Forces pushing up equal forces pushing down
                   g. Many natural arch bridges
                   h. First man-made true one at least 6,000 years ago
                   i. Rocks piled over a river
                   j. Not used until about 500 years ago
Assessment Sheet 6-1

Answer the following questions from Focus Sheet 6-2. (25 points each)

1. What are the four bridge forms in this article?

2. What are the differences between simple beams and other types of beams?

3. What is a more useful definition of force?

4. What are two conditions must be met to assure equilibrium?
## Self Evaluation Form

Name:

Score:

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Myself</th>
<th>Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>I learned how to identify specialized vocabulary.</td>
<td>5 4 3 2 1</td>
<td>5 4 3 2 1</td>
</tr>
<tr>
<td>I know how to read figures.</td>
<td>5 4 3 2 1</td>
<td>5 4 3 2 1</td>
</tr>
<tr>
<td>I learned how to obtain the most important information.</td>
<td>5 4 3 2 1</td>
<td>5 4 3 2 1</td>
</tr>
<tr>
<td>I worked well with my group.</td>
<td>5 4 3 2 1</td>
<td>5 4 3 2 1</td>
</tr>
<tr>
<td>I made my statements clear.</td>
<td>5 4 3 2 1</td>
<td>5 4 3 2 1</td>
</tr>
</tbody>
</table>

5: excellent  
4: good  
3: average  
2: needs improvement  
1: poor

How can I improve my learning?

How can I read figures?
REFERENCES


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Yang, N. (1993). Understanding Chinese students' language beliefs and learning strategy use. Paper presented at the 27th annual meeting of the teachers of English to speakers of other languages, Atlanta, GA.


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