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A Culturally and Linguistically Responsive Curriculum for Secondary Biology Teachers

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A CULTURALLY AND LINGUISTICALLY RESPONSIVE CURRICULUM FOR SECONDARY BIOLOGY TEACHERS

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Research was conducted in the following areas, which help support the need for a culturally and linguistically responsive curriculum for secondary biology teachers. The history of both bilingual education and science, the importance of bilingual education, a summarization of selected bilingual and ESL models, bilingual and science curriculum, supported bilingual research, standardized tests, science and ELL students, and in closing secondary bilingual research. Based on the conducted research, the curriculum was developed utilizing the late-exit bilingual model, preview/review, and the incorporation of the student's culture.

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CHAPTER I

INTRODUCTION

General Problem

This project is to develop a culturally and linguistically responsive curriculum for secondary biology teachers of students in high school English as a Second Language (ESL) programs. The 2005 Washington Assessment of Student Learning (WASL) science achievement scores showed that 26% of the student population meets the state science standards (OSPI, 2005). An astonishing point is that only 3% of the English as a Second Language (ESL) students meet state science standards (OSPI, 2005). As a result, ESL students will not be able to graduate from high school, attend college or pursue a high paying job. Therefore a bilingual science curriculum would support the improvement of WASL science achievement scores of ESL students.

Background of the Problem

According to Fensham (1992), science education has relied on three specific reform efforts. First, there has been a radical shift in thinking about who should be competent in science. In the past, science achievement was expected only from the elite who had made it to advanced secondary school. Second, science education has been adapted to ensure greater equity in order to reduce gender biases. Thus the focus has been on girls. The third major trend in science education has been the increase in the constructivist approach. Fensham (1992) illustrates these major trends in science education, however these trends do not take into account the needs of ELL students. Science students who are not native English speakers face both linguistic and cultural

barriers when trying to acquire science knowledge in the regular classroom. There has been little recognition of the linguistic and cultural resources that individual groups bring to the science classroom and how these resources can be articulated into the science disciplines to enhance student learning (Lee, 2002, 2003).

It is a pressing need to be an educated citizen in the informational and technological 21st century. Therefore it is imperative that student diversity be addressed in science classrooms. International and national studies have found there to be an achievement gap between mainstream and non-mainstream students, but have also found that U.S. students overall have performed poorly in science education (Campbell et.al, 2000). Reasons for these different outcomes suggest that current educational policies and practices do not generally support science outcomes with English Language Learners (ELL) students. Knowledge and practices that ELL students bring to the science classrooms are not incorporated into the curriculum. By incorporating the student's cultural background into the curriculum, learning is enhanced because it is now culturally and cognitively meaningful and relevant to the students (Lee, 2005). Furthermore, because of the high-stakes assessments and the accountability facing today's schools, schools need to integrate academic disciplines with knowledge of English language and literacy development.

According to the Washington State Language Proficiency Test (WLPT), Late Exit Bilingual Education models have proved to be successful among ESL students (WLPT, 2002). Studies conducted by Thomas and Collier (1997) have indicated a positive achievement growth because of the implementation of bilingual education. Both the Two-Way Bilingual

Education and Late Exit Bilingual Education with content ESL, demonstrate a positive academic growth among ESL students (WLPT, 2003). Currently there is little research supporting a bilingual secondary curriculum for high school students. However, much research has been conducted to support bilingual education in the primary levels of education.

Purpose

This non-thesis project is to develop a linguistically culturally responsive science curriculum for teachers of students in high school English as a Second Language (ESL) programs. The scope of this project is to develop a curriculum that assists teachers in presenting linguistically and culturally responsive science materials. The curriculum will also serve to help enhance the science knowledge of students in ESL programs.

Research Questions & Procedure

This non-thesis project will help ESL students to succeed not only academically but also socially. Through the inclusion of bilingual strategies into the high school biology curriculum, the teacher will be able to meet the needs of the ESL students. The curriculum will have the regular content material that needs to be addressed according to the Washington state standards. Both English and Spanish will be used for instructional purposes. The idea behind the preview/view/review format of the curriculum is that ESL students will receive an overview or the anticipatory set in their native language so that they may understand and comprehend the material to follow. The core concepts will then be delivered in the second language, utilizing sheltering techniques. As previously mentioned, this model is called the Late-Exit Bilingual Education plus Content ESL model, otherwise known as the Maintenance model.

Researchers have confirmed that the development of student's native language skills shows beneficial effects on their English-language development and overall academic achievement. Stephen Krashen, a linguist at the University of Southern California, suggests that when students are given quality education in their primary language, they receive both knowledge and literacy (Crawford, 1999). The time spent studying in the native language supports English acquisition. Greene (1998), an assistant professor of government at the University of Texas, conducted a statistical review of literature on the effectiveness of bilingual education. Greene found that students with limited English proficiency who are taught using at least some of their native language perform significantly better on standardized tests than similar students who are taught only in English. Current theory suggests that within well-developed programs, subject matter and literacy development taught in the first language, along with quality comprehensible input delivered in English, has positive effects on ESL students (Krashen, 1998).

The following curriculum will help increase language proficiency and academic ability in both English and Spanish. Because of the supported research that has been conducted to improve the academic success of ESL students, it is imperative that educators acknowledge and address the need for the application of both ESL strategies and successful bilingual models into the curriculum.

CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

A review of research and literature has been summarized in chapter two to address key components essential in helping support the development of the purposed curriculum. The major components included in chapter two are: (1) the history of both bilingual education and science, (2) the importance of bilingual education, (3) a summarization of selected bilingual and ESL models, (4) bilingual and science curriculum supported by bilingual research, (5) standardized tests, science, and ELL students, and in closing (6) secondary bilingual research.

The research addressed in Chapter two was identified through an Educational Resources Information Center (ERIC) computer research. In addition, the Internet online and the Bilingual Research Journal were used for research.

History of ESL

Bilingual Education

Bilingual education has been contested in the United States for centuries, dating back as far as the colonization period, setting the stage for the role of symbolic politics of language and ethnic identity (Ovando, Collier, & Combs, 2003). However, the nation's founders did not adopt neither "an official language nor a government sanctioned body to regulate speech" (Crawford, 1999). During the restrictive period, 1880-1960's, monolingual English instruction was heavily emphasized (Baker & Jones, 1998). Never

the less, the debate over the role of non-English native language instruction had begun.

In 1958, the National Defense Education Act (NDEA) was developed. During this period, the former Soviet Union launched Sputnik, motivating the federal government to establish the act. The NDEA encompassed policies with regard to foreign languages, mathematics, and science. One of the acts' primary goals was to improve the amount of foreign language education in the United States (Ovando, 2003). Traditionally, monolingual English was still implemented, destroying the cultural backgrounds and linguistic gifts students brought to the schools. The failure to accommodate ESL students slowly began to change in the 1960's as a result of the civil rights movement and the 1964 Civil Rights Act.

During the 1960's, the civil rights movement also affected immigration laws. The 1965 Immigration Act permitted larger numbers of Asians and Latin Americans to enter the country. As a result of this demographic change, more and more language minority students appeared in U.S. classrooms where bilingual instruction was needed (Ovando, 2003). Bilingual education became a necessity for the increasing amount of minority students.

Science and ELL students

Performance by minority students in science lags behind their majority peers (Merino & Hammond, 1998). Science education reforms in the 1980's promoted hands-on activities and a constructivist approach. New methodologies emerged to promote success in multicultural populations, however, these activities were so linguistically demanding that, unless modified, they excluded ELL students even more than traditional computational activities (Merino & Hammond, 1998). According to Fensham (1992),

science education followed several major trends without taking into consideration ELL students.

In the past, science achievement was expected only to be the domain of the elite who had made it to advanced secondary school. Science education was adapted to ensure greater equity in order to reduce gender biases. Recent trends have focused on girls. Another major trend in science education includes the constructivist approach. However, these trends did not consider the needs of ELL students, leaving students to face both linguistic and cultural barriers in the acquisition of science concepts in the regular classroom (Merino & Hammond, 1998). Content area instruction needs to be a meaningful context for English language and literacy development (Lee, 2005). Science policies and practices generally do not support the desired science outcomes with ELL students (Lee, 2005).

Many educational policies and practices do not take into consideration the maintenance and/or development of ELL's oral and written skills in their native language as academically relevant to achievement (Lee, 2005). Funds of knowledge is a concept encompassing the students' background knowledge. Funds of knowledge need to be integrated into the curriculum by teachers who identify and document knowledge that exists in students' homes (Gonzalez et.al, 1993). Large-scale assessments have not considered or consistently been implemented with ELL students in mind, resulting in the collection of imprecise information about the strengths, needs, and academic progress of these students (Lee, 2005). Hundreds of science and mathematic reports have been issued, revealing the under-representation of minority students (Blake, 2004). Therefore, it must be acknowledged that a science curriculum that is culturally responsive and

tailored to the needs of ELL students would increase the educational success of these students (Lee, 2005).

ESL students need to have the option of entering the science field. In 1990, Latinos only represented 3.1% of the science and engineering work force (Blake, 2004). In order for individuals to enter careers in science they must have the opportunities to learn and achieve in science, and they must make the decision to enter science related fields (Oaks, 1990). According to McKeon (1994), at least 50% of all U.S. teachers will have one or more ELL students in their classes at some point in their careers. Therefore, efforts need to be made to provide training for teachers in order to help meet student needs.

The Importance of Bilingual Education

What is Language?

According to the American Speech-Language-Hearing Association (1983), language is a complex and dynamic system of controversial symbols used in various modes for communication and thought. Humans use language to convey messages to one another through body movements, gestures, and sounds. Depending on a person's background, different expressions can convey different meanings.

What is bilingualism?

Bilingualism can be defined as the ability to possess equally adequate skills to communicate in two languages. Bilingualism can also be defined as the utilization of two languages to communicate while the speaker only excels in one of the languages. Being biliterate is the ability to read, write, listen and speak effectively in both languages.

People who are bilingual need to be continually engaged in both their native language and second language in order to help retain their fluency. Evidence suggests that the acquisition of two or more languages provides positive consequences for meta-linguistic development (Bialystok, 1991). It has also been reported that children who have acquired literacy in two languages performed significantly better in the acquisition of a third language than did children from monolingual backgrounds (Swain & Lapkin, 1991). Positive results of bilingual programs that support L1 can be attributed to the combined effects of reinforcing students' cultural identity and their conceptual growth (Cummins, 1992).

Interdependence of First and Second Languages

The interdependence principle has been stated by Cummins (1981) as: "To the extent that instruction in Lx is effective in promoting proficiency in Lx, transfer of this proficiency to Ly will occur provided there is adequate exposure to Ly (either in school or environment) and adequate motivation to learn Ly" (p. ?). The term common underlying proficiency (CUP) has been used to refer to the linguistic proficiency which underlies academic performance in both languages (Cummins, 1998). Knowledge is transferred from the students' primary language to the second language. Fitzgerald's comprehensive review (1995) (as cited in Cummins, 1998) of research on cognitive reading processes among ESL learners concluded that in the United States, ESL readers used knowledge of their native language as they read in English. Fitzgerald's research supports the current view that native-language development enhances reading in ESL.

Research also suggests a moderately strong correlation between bilingual students' first and second language literacy skills, in which students have had the

opportunity to develop literacy in both languages (Cummins, 1998). Genesee (1979), (as cited in Cummins, 1998) points out that CUP can also be applied to closely related and dissimilar languages. Research suggests within bilingual programs, instructional time can be devoted or focused on developing students' literacy skills in their primary language without having any adverse effects on the literacy development of the second language (Cummins, 1998).

Summary of Selected Bilingual and ESL Models

Since 1991, the population of ESL students in the U.S. has increased by 95% from 2.4 million to 4.7 million ELL's (OELA, 2002). Garcia (1994), (as cited in Paredes Scribner, 1995) suggests if immigration patterns continue at the current rate, by the year 2026, schools will be educating approximately 15 million students from culturally and linguistically diverse backgrounds. These statistics indicate the importance in addressing which programs are currently being implemented to serve ELL students and what results these programs have evidenced.

According to Ovando and Collier (1998), ESL programs are typically found in school districts where the language minority population comes from different language backgrounds. Ovando and Collier (1998) describe ESL as the following:

- ESL is a system of instruction that enables students who are not proficient in English to acquire academic proficiency in spoken and written English.
- ESL is an essential component of all bilingual education programs in the United States for students who are English learners.

- ESL classes taught through academic content are crucial for English language learners when first-language academic instruction is not feasible.

Bilingual programs, by contrast, use both the students' native language or (L1) and the second language or (L2). Bilingual programs are typically used in school districts where the language minority population comes from the same language background, unlike ESL programs which include students from multiple linguistic traditions.

ESL Pullout

The ESL pullout method is organized in a variety of ways. Some students may be "pulled out" of their regular program of studies for an hour a day while other children receive instruction for 30 minutes a day. ESL pullout is categorized as a subtractive model, meaning the students' first language is lost (Cummins, 2000).

Sheltered Instruction

The sheltered instruction model groups language minority students from different language backgrounds into classes in which teachers provide academic content instruction in English. Gestures and visual aids are used in class to help students understand the content. According to Ovando and Collier (1998) the sheltered instruction model is a natural, stimulating, and practical way to acquire English.

Teachers integrate both language and content goals into each lesson. The content instruction is taught by a teacher who is certified in the subject being taught, but also has training ESL methodology (Ovando & Collier, 1998). Sheltered instruction has proven to be more effective then ESL pullout models because of the accessibility to the total school

curriculum. Also, students are given the opportunity to be taught academic content while learning English (Ovando & Collier, 1998).

Transitional or Early-Exit Bilingual Education

In transitional programs, also known as "early-exit bilingual programs," content instruction is given to students in both their native language and in English. In transitional bilingual education (TBE), the native language is used as a foundation for English reading and writing. The goal of TBE is to phase students into all-English instruction. TBE uses the native language for about one-third of the time in class, but is then rapidly phased-out thereafter (Cummins & Genzuk, 1991).

Transitional bilingual education generally provides students services for two to three years (Ovando, 2003). The program is based on the misconception that two years is sufficient time to acquire a second language. Research suggests that conversational skills often approach native-like proficiencies within two years of exposure to English, whereas a period of four to nine (Collier, 1987) or five to seven years (Cummins, 1981) of exposure is required for ESL students to acquire academic aspects of English. Academic language proficiency refers to both reading and writing abilities in content areas where students are required to use their language abilities for learning (Cummins, 1989). Although the goal of the program is to phase students into English only instruction, TBE places students into mainstream classes before they are ready.

Maintenance or Late-Exit Bilingual Education

Within maintenance program models, both the native and second language are used for content instruction. The goal of the program is to develop and maintain the

native language of students, allowing them to preserve their native culture while acquiring a second language. Unlike the early-exit model, maintenance models do not emphasize the necessity for rapid exit into mainstream classrooms. On the contrary, students in maintenance programs receive content-area instruction in both languages, even after they become proficient in the second language (Ovando, 2003).

Instruction in the native language can vary according to grade-level. For example, the native language might be taught while English is used about one third of the time. In other models half or 60% of the time is dedicated to the use of the native language. Maintance or late-exit programs were ideally planned for grades K-12, but have rarely been implemented beyond elementary school in the U.S (Thomas & Collier, 1997). Ovando and Collier (1998) suggest that students in maintenance bilingual education programs are academically successful when given tests in the second language after four to six years of bilingual schooling.

Two-Way Bilingual Education or Dual immersion

Within the two-way model, language minority students from the same linguistic background have typically been grouped with language majority or English-speaking students in the same classroom. Dual immersion programs have become extremely popular. These programs share common characteristics but also vary in several different aspects (Gomez et.al, 2005). For instance, many of the programs include students with fluent English proficiency, limited English proficiency, and students who are a mix of economically advantaged and disadvantaged backgrounds (Gomez et.al, 2005). Two basic dual language program models are the 50/50 and the 90/10 models. The 50/50

model divides the language of the instruction by content area and by time. The advantages of this program are many, including quality language instruction in both languages, positive interdependence among peers, native language development. This program provides a prospective enrichment model for districts as well as an effective means of school reform (Ovando & Collier, 1998).

The goal of ESL programs has been to help students attain proficiency in English as quickly as possible so they can be admitted into a mainstream classroom. Such transitional models are considered to be "subtractive" because the development of the second language takes precedence over the native language. However, the goal of bilingual programs is to develop both the native language and the second language so students can maintain their native language and their culture while acquiring content area knowledge. Therefore, bilingual programs are considered to be "additive" models because students can acquire proficiency in both the native language and the second language (Brisk, 1998).

Successful programs need strong support from their school district administrators, principal, and parents. Bilingual programs need to be integrated into the entire school with teachers who have appropriate teaching credentials, strong content knowledge, positive classroom management skills and native or native like proficiency in one or both languages being used (Lindhom et.al, 2004).

Curriculum

Bilingual Education-Curriculum

There are different types of curriculums that can be used within a bilingual program. The purposed curriculum builds upon content-based instruction. The Cognitive Academic Language Learning Approach (CALLA) focuses not only on the students' Basic Interpersonal Communication Skills (BICS), but also their Cognitive Academic Language Proficiency Skills (CALPS). CALLA emphasizes the importance of content based instruction, while building on the learner's experiences and existing knowledge of the subject matter. Many students lack the academic language skills that enable them to use English as an explicit tool to learn strategies for both content and language acquisition (Chamot & O'Malley, 1994).

Because CALPS can take 5-7 years to develop, it is imperative to implement a bilingual curriculum. The growth in numbers of ESL students and shortage of qualified ESL and bilingual teachers requires the need to teach content outside ESL classrooms (Echevarria et. al, 2004). This need is most adequately addressed by developing sheltered content instruction (Echevarria et. al, 2004).

Sheltered instruction allows ELL students to participate in content area classrooms with grade level objectives delivered through modified instruction (Echevarria et. al, 2004). ESL students not only need to learn vocabulary and grammar, but also the way English is used in core content classes. According to Short (2002), academic literacy includes knowledge of English, knowledge of the content topic, and knowledge of how tasks associated with the discipline are to be accomplished. Content

area teachers often modify their instruction with a more hands-on approach and less direct instruction.

Science Curriculum

In order to help children succeed, students need to be challenged. By challenging students to think and apply their skills in science, they will be able to apply those same thinking skills across other subject matters. Inquiry-based instruction challenges students to "think outside the box" while applying the same skills in other areas. As previously mentioned, ESL students need to have a curriculum that is both culturally responsive and academically challenging. Research suggests that students who learn science through a second language score poorly when compared to students who learn science in their native language on achievement tests (Yip et. al, 2003). In order to help students acquire the necessary knowledge to succeed in college or in the work place, they need to be offered challenging, inquiry-based courses that emphasize problem solving. Students should not be limited to the typical low level courses which emphasize segmented skills, and worksheets with little opportunity for oral language development and interactive learning (Paredes Scribner, 1995). The connections and support for student learning provided through integrated inquiry are is essential in helping ESL students succeed in science classrooms (Blake et.al, 2004).

Integrated inquiry is one way for teachers to help students associate facts with concepts and ideas. This method provides students with real-life situations or hands-on activities. De la Cruz (1998) (as cited in Blake, Hurley, & Tinajero, 2004) suggests people learn language when placed in real situations where communication is valued. Therefore, literacy development in science depends heavily on how activities are

constructed. Science activities need to be designed to help students investigate, gather, organize, analyze, and evaluate information (Blake et.al, 2004). In order to help include each of these processes into student learning, educators have moved toward standards-based curricula (Blake et.al, 2004).

Standards-based instruction helps to identify what students should know and what they should be able to do at particular grade-level benchmarks designed to raise expectations and achievement. According to August (1994), in order for ESL students to meet high standards, schooling must be tailored to their strengths and needs. August (1994) recommends that content can be most effectively taught to ELLs when the students' cultural backgrounds and life experiences are incorporated in the curriculum, high quality instruction is provided, and a multifaceted approach is established to enhance learning.

Bilingual Education – Supported Research

Bilingual Models

Wayne P. Thomas and Virginia Collier (1997) from George Mason University conducted a longitudinal study consisting of a series of investigations concerning the performance of language minority students in five school districts from 1985 to 2001. This longitudinal study provided information on school effectiveness for language minority students. The study analyzed some of the most promising models for educating language minority students and their resulting outcomes. Thomas and Collier found that LEP students fared best in two-way bilingual programs, learning alongside English-

speakers acquiring Spanish or another target language (Crawford, 1998). According to Thomas & Collier (2002),

> The findings of the research study demonstrate that it is crucial that educators provide a socioculturally supportive school environment for language minority students that allows natural language, academic, and cognitive development to flourish in both L1 and L2, comparable to the sociocultural support for ongoing language, academic, and cognitive development that native-English speakers are provided in school (CREDE, 2006).

Moreover, the study serves as a corner stone to support bilingual education. To view The Academic Effectiveness of Bilingual Education Models, see Appendix D.

Second Language Acquisition Theories

Stephen Krashen, a professor at the University of Southern California, is a major proponent of bilingual education. In 1983, along with the assistance of Tracy Terrell, Krashen developed the Natural Approach. The Natural Approach is based on the use of language in communicative situations without recourse to the native language. The approach focuses on comprehensible input rather than practice drills. A prolonged period of time is provided for learners to acquire the language before they try to produce vergbal or written communication.

Krashen's language acquisition theory involves five hypotheses. The acquisition-learning hypothesis describes acquisition and learning as two distinctive ways to learn a language (Richards & Rodgers, 2001). Learning is a conscious process while acquisition can be described as an unconscious process. The second hypothesis is the monitor hypothesis in which the learner actively meta-cognates on the oral production. Krashen's

natural order hypothesis suggests the acquisition of grammatical structures occurs in a predictable order. Fourth, the input hypothesis explains the relationship between exposure and language acquisition (i + 1). The fifth and final hypothesis is the affective filter hypothesis, in which learner's attitudes and emotional states are seen to filter, impede, pass, or block necessary input. A low affective filter is desirable, because it does not block input (Richards & Rodgers, 2001).

Transfer from L1 to L2

Jim Cummins, from The Ontario Institute for Studies in Education, proposes that knowledge from the students L1 automatically transfers to the L2. Cummins (1989) believes it is important for educators to be aware of the difference between BICS and CALPS because failure to recognize the distinction between conversational and academic language skills can result in discriminatory testing of minority students and the premature exit of students from bilingual programs into all-English programs. Failure to take into account the distinctions between BICS and CALPS, results in minority students' academic difficulties, low academic performance, and the false interpretation of deficient cognitive abilities or motivation (Cummins, 1989).

Efficacy of Bilingual Models

Greene (1998), an assistant professor of Government at the University of Texas, conducted a systematic, statistical review of literature on the effectiveness of bilingual education. His review indicated that students "...with limited English proficiency who are taught using at least some of their native language perform significantly better on standardized tests than similar students who are taught only in English" (p. 1). His

research consisted of a combination of eleven studies including standardized test score results from 2,719 students. Over half of these students or 1,562 individuals were in a bilingual program. The eleven studies included in his meta-analysis were drawn from a list of 75 studies compiled by Christine Rossell and Keith Baker (1996). Rossell and Baker (1996), who are strong vocal critics of bilingual education, deemed the studies as "methodologically acceptable" in a 1996 literature review (Greene, 1998). Greene (1998) describes the method the previous authors use in selecting the eleven studies. He also accounts for the differences between his results and those of Rossell and Baker's results.

Greene found that Rossell and Baker (1996) reported different number of positive and negative studies for several reasons. First, they included studies instead of which that were redundant, unavailable, were not evaluations of bilingual programs, or without English-only control groups (Greene, 1998). Second, Rossell and Baker did not apply a consistent rule for classifying studies as positive or negative (Greene, 1998). Third, some of the studies in their categories of positive and negative investigations were not found on their list of acceptable studies (Greene, 1998). Greene (1998) suggests that because of the lack of rigor and consistency in how these authors classified studies and summarized their results, conclusions drawn from their research are unreliable. In contrast, Greene (1998) found that students who were taught in their L1 performed better on standardized tests then native English speaking students using data deemed as "methodologically acceptable" by these bilingual education critics.

Standardized Tests

Washington Assessment of Student Learning (WASL)

The WASL was adopted as part of the Outcome Based Education movement. The concept of the WASL was first designed originally by the National Center on Education and Economy (NCEE) (Wikepedia, 2006). The test was developed by educational psychologists, classroom teachers, and curriculum specialists from across Washington State. Hundreds of questions were developed to create a pool of questions, allowing for the creation of new assessment forms each year from the sample pool (OSPI, 2006).

This state assessment requires students to provide answers to demonstrate their knowledge, skills and understanding of each of the Essential Academic Learning Requirements (EALRs) (OSPI, 2006). The test is standardized and "on demand," meaning all students in this state respond to the same questions at the same time. The assessment includes reading, writing, math and science. Students in third through eighth grade take the reading and mathematics portion of the test. In addition, students in fifth and eighth grade take the science portion of the test and fourth and seventh graders take the writing portion (Wikepedia, 2006). Sophomores in high school take all portions of the test and are currently required to pass all four portions in order to meet graduation requirements.

The WASL has been a controversial assessment since it first began to be used in public schools. Many educators believe the WASL should not be used for high stakes purposes such as grade promotion or graduation. Parental groups have protested against the WASL claiming the test requires unreasonable expectations and unusual questions. Others believe the assessment is flawed in both its construction and scoring. Currently a

large percentage of the student body does not pass one or more sections of the WASL (Wikepedia, 2006). As previously mentioned in the first chapter, the 2005 Washington Assessment of Student Learning (WASL) science achievement scores showed that only 26% of the total student population met the state science standards (OSPI, 2005). Out of these students, only 3% of all the English as a Second Language (ESL) students met state science standards which is an astonishing point of consideration (OSPI, 2005).

Several biases exists regarding the WASL. One of these biases is that teachers have to take instructional time to teach WASL vocabulary because the test uses technical language to ask questions. This may be one of the reasons why only 26% of the student population is passed the science portion in 2005. Vocabulary usage is not only a problem for regular content area teachers; ESL teachers have to teach the vocabulary plus other language structures. The WASL is printed only in English, which creates an enormous amount of pressure on the students.

ESL students who have not acquired the academic language or CALPS are considered to be set up for failure because the test is in academic English. Language is what makes it possible to associate facts with concepts and ideas (Blake et.al, 2004). This naturally elicits the question of how ESL students can create these kinds of associations without knowing the target language. Thought and language are so closely connected, that when building on students' cultural background it provides structure and meaning to not only science, but literacy development (Blake et.al, 2004).

Another key point considers whether the test is culturally relevant to the students or biased against ELL students. ESL students not only need to be able to read and

comprehend the English language, but they need to be able to relate to the content in the test, on the same level as native English speakers.

All students need to be able to associate a particular amount of background knowledge with the test questions. An English Language learner might interpret a concept differently then a native English speaker based on their life experience. Therefore, it is not only imperative that teachers try to teach academic language through a culturally relevant curriculum, but also assess their students' learning correctly. In order for ELL students to succeed in school and become productive citizens in our society, they need to receive better educational opportunities in U.S. schools (Echevarria et.al, 2004). This mandate includes the provision of appropriately trained teaching personnel and an expansion of the limited amount of resources used to help meet the substantial needs of ELL students (Paredes Scribner, 1995). If educators are going to reverse the tide of underachievement of language minority students, they need to improve the way they teach Hispanic secondary students, who represent a large segment of the student population (Paredes Scribner, 1995).

While it is important to recognize the implications of the WASL concerning language and cultural barriers for ELLs, according to Cummins (1989),

> Understanding the why and how minority students are failing academically requires that educators dig a little deeper than superficial linguistic mismatches between home and school or insufficient exposure to English. Underachievement is not caused by lack of fluency in English. Underachievement is the result of particular kinds of interactions in school that lead minority students to mentally withdraw from academic effort. (p. 8)

Science education with English language learners

A Culturally Relevant Curriculum

Okhee Lee (2005), from the University of Miami, published a review of educational research regarding science education with English language learners. Within his review, he addressed several different topics, ranging from science learning outcomes, to theoretical perspectives to science learning, science curriculum, and science instruction (Lee, 2005). His review also explains successful programs that have been effective with ESL students.

Lee (2005) stressed the importance of effective science instruction and how it must consider students' languages and cultures. Lee (2005) emphasizes how some studies address science instruction in relation to students' beliefs and practices from a cultural perspective while other studies address linguistic processes. Students bring different cultural experiences that they have acquired in their homes and communities to the classroom. Their cultural beliefs and backgrounds are sometimes incongruent with those of the school (Lee, 2005). Therefore, Lee (2005) suggests teachers need to be aware of a variety of linguistic and cultural traditions to understand how different students approach science learning. Research suggests that in order to assist students in constructing new knowledge, teachers need to establish and bring together different discourses and knowledge, including the science disciplines, the science classroom, and the students' lives (Lee, 2005).

Lee (2004) and his colleagues implemented an instructional intervention including 1,500 linguistically and culturally diverse third and fourth grade students from six elementary schools. The intervention consisted of instructional units, teacher

workshops, and classroom practices. Lee (2004) and colleagues examined the intervention's impact on the science and literacy achievement of the participating students. The study concluded the intervention improved students' science achievement, literacy achievement, and inquiry abilities (Lee, 2005).

As previously described, teachers need to bring together science and students' lives. Research suggests that teachers can increase both the classroom participation and academic achievement of students from different ethnic and cultural groups by modifying their instruction so that it draws on their cultural and linguistic strengths (Banks, 2004b). Research also indicates that cooperative rather than competitive teaching strategies help both African-American students and Mexican-American students to increase their academic achievement (Aronson & Gonzalez, 1988). In order to create instruction that integrates the cultural backgrounds of students, educators need to adhere to five multicultural dimensions.

Multiculturalism can be better understood and implemented when educators are able to identify, differentiate, and understand the meanings of each of the following dimensions (Banks, 2004b). The first dimension is content integration in which teachers use examples and content from a variety of cultures and groups to illustrate key concepts, principles, generalizations, and theories. The second dimension is the knowledge construction process in which teachers use methods, activities, and questions, as stated by Banks (2004b) to ". . .help students to understand, investigate and determine how implicit cultural assumptions, frames of reference, perspectives, and biases within a discipline influence the ways in which knowledge is constructed within it" (p.5).

The third dimension described by Banks (2004b) is prejudice reduction, in which teaching methods and materials can help modify student's racial attitudes. The fourth dimension is an equity pedagogy which exists when teachers modify their teaching in order to facilitate academic achievement among students from diverse racial, cultural, and social-class groups (Banks, 2004b). The fifth and final dimension described by Banks (2004b) involves empowering school culture and social structure by examining the examination of labeling practices, sport participation, disproportionality in achievement, and the interaction between staff and students across ethnic and racial lines. In order for the five dimensions of multicultural education to be implemented successfully, institutional changes need to be made, including, changes in the curriculum, teaching materials, teaching and learning styles, attitudes, perceptions and behaviors of teachers and administrators (Banks, 2004b).

To help create a culturally responsive classroom, teachers need to use a range of culturally sensitive instructional methods and materials. Through explicit and strategic instruction, interdisciplinary units, scaffolded instruction, journal writing, and open-ended projects, teachers can better meet the needs of their students (Montgomery, 2001). Teachers also need to establish a classroom atmosphere that respects individuals and their cultures, while fostering an interactive learning environment (Montgomery, 2001). Collaboration with other professionals and families is also essential in creating a culturally responsive classroom (Montgomery, 2001). Families are a critical component in a strong instructional program and should be regularly informed about students' progress (Montgomery, 2001).

Secondary Bilingual Research

Chapter two has briefly summarized research specific to second language acquisition and bilingual programs. Much of the supported literature has been associated with the elementary grades. Over the years, changes have been made to help meet the needs of ELLs as a result of legal decisions, including Diana v. Board of Education (1970) and Lau v. Nichols (1974) (Paredes Scribner, 1995). Nevertheless, emphasis has been placed on elementary school-age students, paying little attention to the needs of ELLs at the secondary level (Paredes Scribner, 1995). The shortage of bilingual teachers and specialized curriculum at the secondary level resulted in this research gap (Thomas & Collier, 1997) as well as the variance within the Hispanic student population (Paredes Scribner, 1995).

Hispanic students range from those individuals who come with strong educational backgrounds from their home country to those students who have never had any formal education (Paredes Scribner, 1995). As previously described, Garcia (1994), (as cited in Paredes Scribner, 1995) suggests that if immigration patterns continue at the current rate, by 2026 schools will be educating approximately 15 million students from culturally and linguistically diverse backgrounds. Even though the numbers of secondary LEP students continue to increase, few secondary bilingual programs exist to help support the students' native language (Paredes Scribner, 1995).

Thomas and Collier (1997), as previously described, conducted a study that included several different schools in different demographic areas. The study consisted of both elementary and secondary grades and evaluated the subject areas of writing, reading,

math and science. However, there are high schools that are trying to implement an effective bilingual program through the integration of content area instruction.

In these classrooms the preview-review strategy is commonly used. This approach provides students with comprehensible input by presenting a brief overview and review of the lesson in students' native language before and after concepts are presented in the second language (Soltero, 2004). This strategy helps teachers take advantage of the students' first language to provide contextual support for the second language (Soltero, 2004). The use of preview-review benefits all students with different language proficiency levels, since each language is used for either the actual lesson or the preview and review sections of the lesson (Soltero, 2004).

The preview-review strategy is widely used among bilingual programs, including 50/50 and 90/10 models. A study was conducted that compared gains made in second language vocabulary as a direct result of the implementation of concurrent translation and preview-review. Concurrent translation occurs when a teacher says something in one language and immediately translates the message into the students' second language (Freeman et.al, 2005). The study consisted of three third-grade classes in the Los Angeles area who served as the control (no treatment), concurrent translation, and preview-review groups (Ulanoff & Pucci, 1999). Results indicated that not only did the students in the preview-review group score significantly higher than the control and concurrent translation groups, but that the concurrent translation group scored lowest of all three groups (Ulanoff & Pucci, 1999).

Another study conducted by De la Garza and Medina (1985) compared students in a bilingual program using the preview-review strategy to English-dominant children in an

all-English program. The investigation concluded that the bilingual students outperformed the English-dominant children in an all-English program (Krashen et.al, unknown).

It is important for a curriculum to not only be culturally relevant but to also be inquiry based. According to the WLPT (2003), the academic effectiveness of the late exit model does have a great impact on the students when compared to the other indicated models such as early exit and ESL pullout. The two way bilingual model has been shown to supersedes all of the various bilingual models.

In conclusion, the culturally and linguistically responsive curriculum helps students improve their literacy and academic achievement. The following curriculum was written to support teachers and schools who have a predominantly high population of Hispanic students. The curriculum was developed to increase Hispanic students' knowledge of science and to inspire and encourage them to enter science-related careers.

CHAPTER III

PROCEDURES OF THE PROJECT

The purpose of this project was to develop a culturally and linguistically responsive curriculum for secondary biology teachers. To accomplish this purpose, a review of literature was conducted. The research in chapter three was identified through the Educational Research Information Clearinghouse (ERIC) Computer database. In addition online interntet articles and the Bilingual Research Journal were used for information.

This chapter describes information specific to the need for the project, strategies, and procedures utilized in constructing the curriculum.

Need for the Project

The need for this project was influenced by several considerations. First, the 2005 Washington Assessment of Student Learning (WASL) science achievement scores showed 26% of the student population met the state science standards (OSPI, 2005). Only 3% of English as a Second Language (ESL) students met the state science standards (OSPI, 2005). As a result, these ESL students will not be able to graduate from high school, attend college, or pursue a high paying job. A linguistically and culturally responsive curriculum supports the improvement of WASL science achievement scores of ESL students.

Second, as previously described, the population of ESL students in the U.S. has

increased by 95% since 1991, from 2.4 million to 4.7 million ELL's (OELA, 2002). Garcia (1994) (as cited in Paredes Scribner, 1995) suggests if immigration patterns continue at the current rate, by the year 2026, schools will be educating approximately 15 million students from culturally and linguistically diverse backgrounds. Therefore, the increasing number of ELL students calls to attention the need for high school bilingual programs.

Third, even though the numbers of secondary LEP students continue to increase, few secondary bilingual programs exist to help support the students' native language (Paredes Scribner, 1995).

Fourth, ESL students need to have the option of entering the science field. In 1990, Latinos only represented 3.1 percent of the science and engineering work force (Blake et.al, 2004). In order for individuals to enter careers in science, they must have opportunities to learn and achieve in science classrooms, allowing them to make the decision to enter science related fields (Oaks, 1990). Therefore, by creating a cultural and linguistic biology curriculum, secondary Hispanic students will have the opportunity to learn and be encouraged to enter the science work force.

Strategies / Procedures

As previously mentioned, sheltered instruction has been useful for content area teachers to apply. ESL teachers integrate content through the CALLA model. The culturally and linguistically responsive curriculum for secondary biology teachers that follows this chapter fits into a maintenance / late-exit bilingual model.

The curriculum is directed toward 10th grade high school Hispanic students. The students can be monolingual in Spanish but can also be bilingual. These students' proficiency levels in the L1 and L2 can vary. The curriculum will include the students' native language, Spanish, and their second language, English.

The culturally and linguistically responsive curriculum for secondary biology teachers was constructed using the Preview-View-Review strategy. This strategy allows teachers to preview content in students' first languages before they study the content further in the second language (Freeman et.al, 2005). The teacher then reviews the content in the students' first languages (Freeman et.al, 2005). Freeman & Freeman (2000) describe the preview/view/review approach as a means that allows teachers to make the second language more comprehensible through by an introduction or preview in the students' first language. After the preview, the teacher relates the content in the second language using a number of techniques to make the input comprehensible. The lesson ends with a review in the students' first language. Freeman et.al (2005) described the strategy as a means by which students preview and review content in their L1 while viewing content in their L2.

This culturally and linguistically responsive curriculum for secondary biology teachers is centered around one theme. Freeman et.al (2005) describes how ELLs benefit in a variety of ways centering around one big theme. In this manner, students can anticipate and integrate topics is as they begin to study in a new content area. Knowledge and skills transfer across languages and content areas. What students learn in one language is available when they study in the second language.

By organizing curriculum around a theme, teachers can help facilitate transfer (Freeman et.al, 2005). Students also benefit from this culturally and linguistically responsive curriculum for secondary biology teachers because Spanish and English share Latin and Greek roots, providing scientific terminology in the form of cognates (Freeman et.al, 2005). By having one overall theme, teachers provide more opportunities to connect the curriculum to students' lives. These connections make it more interesting for the students (Freeman et.al, 2005). Finally when teachers teach around one theme, there is more opportunity to differentiate instruction by organizing assignments and activities so that all students can participate, regardless of their proficiency skills (Freeman et.al, 2005).

CHAPTER IV

THE PROJECT

The culturally and linguistically responsive curriculum for secondary biology teachers, which was the subject of this project. The activities presented in the following curriculum were identified through an educational resources information center (ERIC) computer research. In addition the internet online was used for research. The curriculum has been presented in three units in Chapter IV as follows:

Curriculum Outline

Unit II: Cells

Unit III: Molecular Basis of Heredity

Unit IV: Human Body Systems

A Culturally and Linguistically Responsive Curriculum for Secondary Biology Teachers

by,

Raquel Georgina Martinez

Central Washington University

August, 2006

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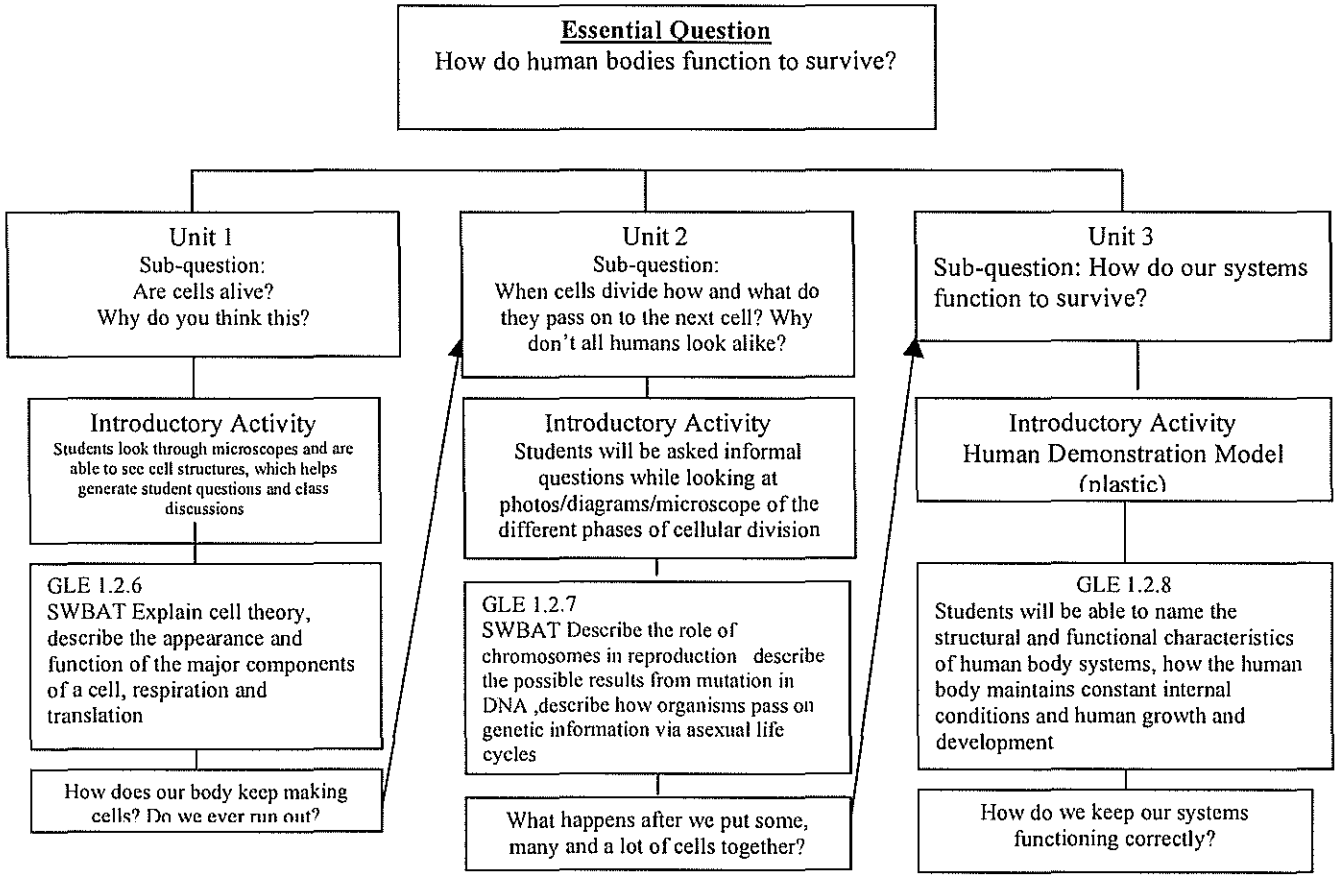
CURRICULUM OUTLINE

Essential Question



UNIT I

CELLS

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CELLS

Unit Essential Question:
Are cells alive? Why do you think this?

Standard	Objective: Lessons 1 & 2
GLE 1.2.6	SWBAT explain the cell theory, describe the appearance and function of the major components of a cell, respiration and translation

	Student Objectives: Lessons 1 & 2
SWBAT:	• Explain and apply cell theory • Describe the appearance and function of the major components of a cell, including: cell membrane, cytoplasm, and the following membrane-bound organelles: nucleus, rough and smooth endoplasmic reticulum, mitochondria, chloroplast, and vacuole. • Describe the appearance and function of some sub-cellular structures, including ribosome's. • Describe how respiration supports protein synthesis which includes copying of DNA into RNA (transcription) and translation of RNA into protein (see Figure 1). • Understand the roles of some important enzymes and macromolecules in protein synthesis, including RNA polymerase, transfer RNA, messenger RNA, and ribosome's.

Instructional Activity

Estimated Lesson Time for Lesson 1: **3 hours**

Lesson 1

Before each lesson students are asked to write down what they know about the given topic in a learning log (or KWL chart). The questions students would be answering are: What did I know before the lesson? What did I learn? What was the same? What was different? How can I relate this information to my life?

Preview (Spanish) Lesson 1: (Estimated time 30 minutes)

Activity Objectives: The teacher will write the following on the board:

- Explain and apply cell theory
- Describe the appearance and function of the major components of a cell, including: cell membrane, cytoplasm, and the following membrane-bound organelles: nucleus, rough and smooth endoplasmic reticulum, mitochondria, chloroplast, and vacuole.
- Describe the appearance and function of some sub-cellular structures, including ribosome's.

Materials Needed:

1. Provided Unit I power point slide show
2. Diagrams of animal and plant cells

Procedure: Possible student questions to elicit class or group discussions. These questions can be given out as a questionnaire to each student.

1. Introduction: The teacher will develop a questionnaire containing the following possible questions so students can understand the importance of the key players in a community:

   ¿Qué es una comunidad? ¿Qué me puedes decir acerca de papeles de comunidad? ¿Quienes son los jugadores claves que ayudan a la comunidad funciónar? ¿Qué me puedes decir acerca de tu comunidad? ¿Más específicamente, qué papel juegan las familias en una comunidad y por qué? ¿Puede funcionar una comunidad sin familias? ¿Por qué piensas esto? ¿Puede funcionar una familia sin una comunidad? ¿Cómo piensas que las familias funcionan o deben de funcionar? ¿En tu opinión que hace una familia funciónar?

2. The teacher will then pass out the questionnaire to students and give them 15 minutes to complete it.

3. After students finish completing the questionnaire, the teacher will guide students into the following questions. The following questions will help redirect the discussion to show that cells function in a similar pattern.
4. These questions will help the students identify or relate to a cell, in that the cell cannot function correctly without its organelles. The following questions will help assess student knowledge about cells.

¿Están vivas las células? ¿Por qué piensas esto?

¡Sí! Las células tienen las características que toda cosa que viva tiene en común como: la orden, metabolismo, la motilidad, la receptividad, la reproducción, el desarrollo, la herencia, la evolución, y las adaptaciones. Las células son las unidades más pequeñas de la vida.

¿Dónde se localizan las células en tu cuerpo?

Tu cuerpo entero está hecho de células. La piel, la sangre, y los órganos son hechos de millón y millones de células. Todas las partes del cuerpo son hechos de células o son los productos de células.

¿Dónde obtienen las células en tu cuerpo energía?

Nuestras células obtienen energía de moléculas orgánicas de alimento, tal como azúcar y almidones, que vienen del ambiente. En células de organismos más altos, los organelles especiales se llaman mitochondria y descomponen estas moléculas de alimento. Este proceso permite las células para capturar energía química para otros medios.

Según la teoría de la célula, propuesto sobre hace 150 años:

Toda cosa que vive es hecha de células. Toda célula vienen de pre-existir células. Las células son las unidades más pequeñas de la vida. La mayoría de las células son muy, muy pequeños, tanto que sólo se pueden ver con la ayuda de un microscopio.

5. The teacher will conduct a brief summary of what was previously discussed in the preview such as:

¡Tu cuerpo se compone de millones de células! Dentro de tu cuerpo, las células tienen diferentes funciones. Tenemos glóbulos, las células de piel, las células de cerebro, y la lista sigue. A pesar de sus diferencias, la mayoría de células en organismos vivos tienen las estructuras y las funciones semejantes.

¿Has visto una célula? ¿Cuándo? ¿Qué te acuerdas de ello? Las oportunidades son, muchos estudiantes habrán visto una célula bajo un microscopio.

6. Introduce key vocabulary:
    - Organelles cell membrane, mitochondria, ribosome, cytoplasm, nucleus, SER, RER, vacuole, cell wall and chloroplast using the provided Unit I power point slide show.

View (English) Lesson 1: (Estimated time 45 minutes) Sheltered instruction

Procedure: After the preview the teacher can use the Unit I slide show to explain the content.

1. Introduction: After the preview in Spanish, continue the delivery of the core concepts in English, using sheltered instruction techniques (visual aids), explaining the following:

Cell Theory

- *Everything that is considered to be alive is made from cells*
- *All cells come from pre-existing cells*
- *Cells are the smallest units of life*
- *The majority of cells are so small that without the help of a microscope they cannot be seen*

Cells found in the animal and plant kingdoms (with just a few exceptions) have these features in common: (See provided Unit I power point slide show).

- *Cell membrane which serves as a boundary between the cell and the outside environment*
- *Cytoplasm containing organelles*
- *Nucleus containing hereditary material (DNA)*
- *Mitochondrion (plural, mitochondria), where cellular respiration takes place (the breakdown of sugars to produce energy for the cell, a process that uses oxygen and produces carbon dioxide and water)*
- *Smooth endoplasmic reticulum where lipids are made*
- *Rough endoplasmic reticulum where proteins are made with the help of ribosome's*

Plant cells have, in addition to those components listed above, the following organelles

- *Chloroplast which uses light energy to convert six carbon dioxide molecules into one organic six-carbon sugar*
- *Cell wall outside the cell membrane which provides additional strength*
- *Vacuole, a large organelle containing water, often with dissolved pigments, waste materials, or other substances*
- *Cells come in many sizes and shapes, as illustrated in Figure 1a and b.*

Figure 1:

(a) Blood cells transport oxygen to the body and defend the body

(b) Fat cells with red blood cells in the background

Activity:

A. *Refer to a textbook to draw a simple diagram of an animal cell in the template provided in Figure 2. Draw to scale and label the following structures: Nucleus, mitochondrion, ribosome, cell membrane, RER and SER. In your drawings briefly note the functions of each organelle. Add organelles as needed.*
B. *Also, refer to a textbook to draw a simple diagram of a plant cell in the template provided in Figure 2.1. Draw to scale and label the following structures: Cell membrane, chloroplast, mitochondrion, ribosome, cell wall, cytoplasm, nucleus, vacuole and RER. In your drawings briefly note the functions of each organelle.*

Figure 2:
Animal Cell-Teachers guide

Figure 2.1:
Plant Cell-Teachers guide

Review (Spanish) Lesson 1: (Estimated time 30 minutes)

Materials Needed:

1. 2 blue or green pieces of fruit roll up .. Golgi Bodies
2. 2 red or yellow pieces of fruit roll up .. Endoplasmic Reticulum
3. 1 teaspoon of round cake sprinkles .. Ribosome's
4. 4 hot tamales .. Mitochondria
5. 4 chocolate covered raisins .. Vacuoles
6. 1 gum ball .. Nucleus

Procedure: Students will create their cell in class and will create their own cell on their own at home. This activity is designed to reinforce the concepts of cell structures and functions. The student produces a cell model from various food items. Each food item will represent a specific part (organelle) of the cell. When the lab is completed, the cell model is edible.

1. Introduction: Supplies for organelles. Sets of this material need to be made and put into small Dixie cups that could be handed out to each group (in pairs). Each group will also need a paper plate and a plastic knife.

   A. This activity was developed since it is difficult for students to visualize cells as three dimensional structures. Most of the student exposure to cell structure is through diagrams in textbooks and it is hard for them to portray the cells as multidimensional. The following are directions to follow in creating The Incredible Edible Cell.

Before Day of Activity:

B. Follow the package directions to mix up batches of Jell-O gelatin mix. Pick a light colored flavor (we used kiwi-strawberry). Darker colors will make it difficult to see the inside of the cell when the model is completed. Every 6 oz package will make up 4 or 5 cells. Add some unflavored Knox gelatin to the Jell-O to make it set up a little stiffer (just regular Jell-O fell apart during our first test). Pour the Jell-O/Knox mixture into individual 9 oz Solo brand plastic cups until they are about two-thirds full. Put them into a refrigerator to set. We had cups that were still set ten days after the activity.

C. Obtain the other food materials to represent the organelles that will be studied. Choose food items that would appear similar to the diagram the students had to use as a guide.

Day of Activity:

D. For each group, provide the following:

- 1Jello/Knox mixture in plastic cup
- 1 paper plate
- 1 small Dixie cup full of cell parts (organelle) materials

- 1 plastic knife
- 1 plastic spoon

Procedure for Activity:

1. Introduction: The teacher will demonstrate the following steps

   A. *Quite la Gelatina de la copa plástica en el plato de papel. Los estudiantes necesitaran correr el cuchillo alrededor de la orilla exterior de la Gelatina para aflojarlo. Hay algunas sugerencias con que usted quizás puede rocíear la copa, como Pam o alguna otra materia antiadherente. El agua tibia corriente sobre la copa puede aflojar también la Gelatina.*
   B. *Corte la Gelatina/Knox por la mitad y la voltea sobre en cima y entonces lo pones en el plato al lado de la parte de abajo.*
   C. *Utilice la cuchara para hacer un hoyo pequeño en la parte de abajo del citoplasma de Gelatina/Knox. Porque con apenas empujar los pedazos de comida, causa la gelatina deshacerse, causando una célula muy desordenada. Pon el gumball en este hoyo para representar el núcleo de la célula.*
   D. *Utilizar la cuchara para hacer los espacios y su esquema como una guía, ponga las otras partes de la célula en la célula. Las partes se pueden poner en cima y de abajo de la célula de Gelatina/Knox*
   E. *Después que metes las partes de la célula, toma la parte primera de la célula y con cuidado lo pones en cima. Si la célula se siente suave, puedes poner las partes patras en la copa plástica, entonces ponerlo sobre el plato de papel. Entonces con cuidado quita la copa plástica.*
   F. *Después de revisar las partes, los estudiantes pueden comerse la célula* (Para extender esta lección, el maestro puede tener los estudiantes crear su propia célula, que utiliza un tipo de alimento de casa que describe su cultura).

Assessment

Self-Assessment through learning logs (or KWL charts)
Semantic map – Contrast Overlay Map (See Figure 2 in Appendix A)
Prompt for writing: "Tell another student what the cell theory is and what it explains" this assessment can either be used in the learning logs or at the end of the activity (Student writes 3-4 sentences explaining process) (O'Malley & Pierce, 1996).

Transitional Activity

Does cellular respiration occur in plant cells? Explain.

Instructional Activity

Estimated time: 1 hour and 15 minutes

Lesson 1 contd.

Materials needed:

1. Cookies (about 5 for every group of 3 to 4 students)
2. Hershey kisses (10 kisses per group)
3. Toothpicks (5 per group)
4. Colored pipe cleaners (10 per group: 4 green, 3 white, 1 red, 2 yellow)
5. Small gumdrops (10 per group, 4 green, 3 white, 1 red, 2 yellow)
6. Pencils
7. Scissors (1 pair per group)

View (English): (Estimated time 45 minutes) Sheltered Instruction

Procedure: Possible student questions for class or group discussions

1. Introduction: Ask the following questions.

   Does cellular respiration occur in plant cells? Explain. Use provided Unit I power point slide show.

   Yes! Although plant cells can create their own molecules of sugar using solar energy, they still need a way to derive chemical energy from these sugars. Cellular respiration allows plants to obtain usable energy. This cellular respiration process takes place in the mitochondria of plant cells.

   What are the membranes in cells made of?

   Membranes are fluid arrangements of phospholipid molecules. The phospholipids form a bilayer with the fatty tails on the interior and the polar phosphate heads on the outer edges. Phospholipids are amphipathic (part hydrophobic and part hydrophilic). The phospholipid bilayer contains many embedded proteins, protein channels, and glycoproteins (proteins with sugars attached).

2. Label the parts of the molecules shown in Figure 3 using an overhead or document camera, wile explaining the following.

Figure 3:

Cells are constantly making and breaking down molecules of all types. Proteins make up a diverse and important category of large biological molecules. Proteins manage biochemical reactions, provide physical strength in cells, aid in cell-to-cell communication, and many other tasks.

3. The teacher will demonstrate the following before students begin:

   A. *Your group will go through a simplified simulation of how proteins are made in the cell. The goal is to see the living cell as a site of constant metabolic activity, not a motionless structure. Another goal is to appreciate how the functions of different organelles are interconnected.*
   B. *Members of each lab group will perform different functions within the simulated cell. The end result will be the production of a small protein.*
   C. *Collect the materials for the lab. Table 1 summarizes what each item represents in the simulation. Refer back to table as needed during the simulation.*

Table 1. Materials and cell structures they represent.

Material:	Represents:
paper models	organelles
lab table or desktop	cell cytoplasm
5 cookies	glucose molecules
10 Hershey's kisses	ATP molecules
10 colored gumdrops	amino acids
5 toothpicks	peptide bonds
10 colored pipe cleaners	transfer RNAs

4. Set up your cell:

   D. *Make models of organelles. One group member cuts out the organelle models shown in Figure 1 of Appendix A, from their handout. You only need one set of organelles for each group. This simulation will only involve two organelles: the mitochondrion and the nucleus; and a ribosome (which is a structure, not an organelle).*

   E. *Place the organelles on your desk or lab table. Pretend that your desk surface is the cytoplasm of the cell and that the edges represent the cell membrane.*

   F. *Divide up the tasks. There will be four players. Table 2 describes the different roles group members will play.*

Table 2. Different roles of players in the simulation.

Player 1 "Sugar Splitting" Enzymes	In the cytoplasm and mitochondria, sugar-splitting enzymes break bonds in sugar molecules to release stored energy. In the process, energy is captured in the bonds of another molecule, ATP, which carries chemical energy to other parts of the cell.
Player 2 RNA Polymerase	In the nucleus, the RNA polymerase copies small segments of DNA to make a complementary RNA molecule. The copy, a "messenger" RNA molecule, leaves the nucleus and heads to a ribosome.
Player 3 Transfer RNA(tRNA) Manager	In the cytoplasm, transfer RNA is linked to an amino acid. This requires energy, usually provided by ATP. The transfer RNA then carries its attached amino acid to the ribosome.
Player 4 Ribosome	Attached to the endoplasmic reticulum, the ribosome "reads" the messenger RNA (mRNA) in three-letter "words," or codons. A transfer RNA brings in an amino acid corresponding to each codon. The amino acids are joined

	together into a chain with help from the ribosome.

Harvesting Energy from Glucose in the Mitochondrion

6. Demonstrate the following simulation of cellular respiration:

   G. *Player 1 places the glucose molecules (cookies) in the mitochondrion and puts the ATP molecules (Hershey's kisses) off to the side.*
   H. *Player 1 (mitochondrial "sugar splitting" enzymes) breaks a cookie in half.*

   This represents breaking the bonds which hold a glucose molecule together. This process uses oxygen gas and releases carbon dioxide and water. Does the breaking of chemical bonds in glucose release energy or consume energy?

   Chemical bonds contain chemical energy. When they are broken, this energy is released, which is what you see when wood burns. Wood is made of cellulose, that is, long chains of sugars. During burning, the cellulose sugars are rapidly combining with oxygen, a process that releases heat energy. The same process occurs in the mitochondrion, but at a controlled rate, and some of the energy is transferred to other molecules such as ATP.

Activity:

Simple visual demonstration of the importance of oxygen and the release of energy:

Materials Needed:

1. Candle (3 inch tall candle, needs to be large enough students can see, but small enough a cup can cover)
2. Clear plastic cup (tall enough to cover the candle

Procedure: As the teacher is explaining how energy is released as heat, the teacher can use this simple demonstration which will allow students to visually see how without oxygen a candle cannot burn.

1. Introduction: Possible questions to ask

   The teacher will ask students, what they think will happen when you light up the candle (small simple candle that is big enough for students to see), will it stay burning? For how long?

   What do you think will happen if we cover the lighted candle with a cup? Why do you think this?
2. The teacher will then cover the candle with a cup (preferably a clear cup so students can see what happens to the flame).

Why do you think the flame burned out? Do you think it will turn back on if I remove the cup and light it again? Why do you think this?

3. The teacher will then proceed to light up the candle again. During this simple demonstration, the students are able to understand that the candle cannot burn (flame) without oxygen.

   Therefore, when the candle is covered the amount of oxygen is dramatically reduced and then used up by the flame. When the candle is uncovered there is enough oxygen for it to stay on.

Assessment
Self-Assessment through learning logs (or KWL charts) Prompt for writing: "Tell another student how the mitochondria stores energy" (Student writes 3-4 sentences explaining process). Students are also assessed through informal questioning throughout the simulation in order to check for understanding (O'Malley & Pierce, 1996).

Review (Spanish) Lesson 1: (Estimated time 30 minutes)

Procedure: Possible student questions for class or group discussions

1. Introduction: Ask the following questions

   ¿Cómo puedes relacionar tu opinión de papeles de familia a los organelles de una célula? ¿Podría funcionar la célula correctamente sin un organelle particular? ¿Qué sucedería si un organelle no estaba? ¿Podría funcionar la célula sin organelles? ¿Más específicamente, podría funcionar el animal o la planta en total? ¿Qué son algunas posibilidades que ocurrirían al animal o la planta (la comunidad) si las células no funcionaban correctamente?

   ¿Cómo son células de planta diferentes de células animales? ¿En qué maneras son semejantes? (Vocabulary has been explained at the beginning of lesson 1)

   Contraste a células animales, las células de planta tienen los cloroplastos, organelles que aceptan energía del sol para hacer moléculas de azúcar durante el proceso de la fotosíntesis. Las células de la planta tienen también paredes de célula que proporcionan la fuerza y el contrapeso físico de la presión que es producida por la vacuola (haciendo una célula rígida). Planta y las células animales son las células de eukaryotic. Ellos tienen muchos organelles en común tal como el núcleo, mitochondria, reticulum áspero y liso de endoplasmic, membrana de citoplasma y célula.

Planta y las células animales respiran (aceptan oxígeno para quebrar azúcares por energía celular) 24 horas por día

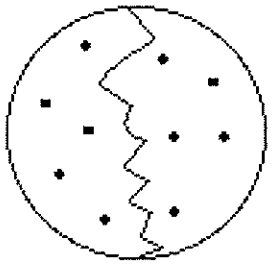
Review Contd.: Harvesting Energy from Glucose in the Mitochondrion

Procedure: The teacher will explain the production and function of ATP through the following activity:

1. Introduction to activity: Demonstrate the following

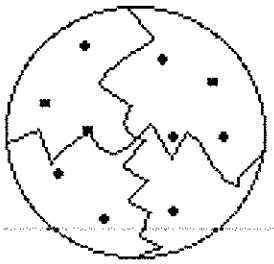
   La célula guarda parte de la energía que fue liberada de los bonos de la glucosa en bonos especiales de moléculas de ATP. ATP se llama el "portador universal de energía de células" porque puede viajar a otros lugares en la célula y proporcionar energía para otras reacciones químicas (tal como la síntesis de la proteína).

2. *Cada vez una galleta se rompe en la mitad, dos moléculas de ATP (los besos de Hershey) son producidos.* El jugador 1 rompe una galleta en la mitad para producir dos moléculas de ATP.



= 2 ATP

3. Entonces, él/ella romperá las dos mitades en la mitad otra vez. *Esto romperá dos más bonos y producirá cuatro más besos de Hershey, o seis ATP total para cada molécula de la glucosa.*



= 2 ATP + 2 ATP + 2 ATP

(3 bonds broken)

Transitional Activity
Player 1 now transports the six ATP molecules to the cytoplasm where they will be used by other members of the group. All cell lessons are interconnected through the simulation activity.

Instructional Activity

Estimated Lesson Time for Lesson 2: **3 hours**

Lesson 2

Before each lesson students are asked to write down what they know about the given topic in a learning log (or KWL chart). The questions students would be answering are: What did I know before the lesson? What did I learn? What was the same? What was different? How can I relate this information to my life?

Preview (Spanish) Lessons 2: (Estimated time 50 minutes)

Activity Objectives: The teacher will write the following on the board:

- Dominar los principios esenciales del vocabulario aplicable a células y a los organelles dentro de cada célula.
- Observar la estructura y organelles generales de células utilizando methylene blue.
- Aplicar su conocimiento del equipo del laboratorio, las sustancias químicas y las operaciones del microscopio.
- Discutir las similitudes y las diferencias entre células de eukaryotic (animal/plant) y prokaryotic (bacteria).
- Observar la estructura de su mejilla y de la bacteria dentro de su boca
- El estudiante será capaz de listar las funciones del principio de cada organelle celular.

Materials Needed:

1. Compound Microscope
2. Cover Slip and Slides
3. Flat Toothpicks, Paper towels
4. Cheek cells (taken in class)
5. Bacteria (taken in class)
6. Methylene Blue

Procedure: Before beginning the questions related to student's families, I would begin the lesson with a lab, in which students are able to not only view different types of cells but their own.

1. Introduction to Activity: The following can be an example of a lab in which students can relate to cellular structures. This lab is used to help students visualize a cell, but also to help lead into the following lesson.

2. Before students prepare their slides for the selected cells to be viewed, the teacher will demonstrate the process by which to obtain the individual cells (Students already know how to use a microscope). As students view the cells, they will be asked to draw out what they see in both the cheek cells and the bacterial cells.

    A. *Los estudiantes utilizarán un palillo de dientes para raspar dentro de la mejilla. Esto liberará algunas células de la mejilla sobre el palillo de dientes.*
    B. *Las células deben de ser desparramadas en un resbaladero limpio con el plano del palillo contra el resbaladero. Los estudiantes deben ver una "mancha" en el resbaladero con sus ojos.*
    C. *Los estudiantes agregan 2-3 gotas de methylene blue a las células, entonces coloca, con cuidado, el tropiezo de la cubierta sobre el área, evitando burbujas de aire.*
    D. *Los estudiantes colocan su resbaladero, de la célula, de mejilla bajo el microscopio y observan sus células de mejilla. Los estudiantes notaran el tamaño, la forma, y algunas partes de células humanas.*

3. After students have observed how cheeks are made up of many cells – students will observe a single-celled organism from slides they prepare.

    A. *Los estudiantes utilizaran un palillo de dientes para raspar entre dientes. Para estar seguro que ellos tienen suficientes bacterias, los estudiantes deben repetir esto entre 2 o 3 dientes.*
    B. *Embaracen el fin del palillo de dientes en un nuevo resbaladero y cubra el área con un tropiezo de la cubierta después de agregar methylene blue.*
    C. *Los estudiantes observan las células de bacterias bajo el microscopio. Los estudiantes deben notar una diferencia en el tamaño y la forma de su resbaladero previo de células de la mejilla.*

4. After students have completed the lab, the teacher will discuss the importance of the structure and function of the cells and will re-direct the discussion towards family roles, utilizing the following procedure.

Procedure: Possible student questions for class or group discussions

1. Introduction: The teacher will develop a questionnaire containing the following possible questions so students can understand the importance of the key players in a family:

    ¿Quiénes piensas que son los jugadores claves en una familia? ¿Qué son los tipos diferentes de papeles en tu familia? ¿Hay dependientes? ¿A quién piensas que son los más importantes en tu familia, es tu mamá, tu papá, tus hermanos, tus abuelitos, o usted y por qué piensas esto? ¿Puede

funcionar una familia sin los jugadores claves? ¿Piensas que tu familia lucharía sin los jugadores claves y por qué? ¿Que piensas que es esencial en mantener una familia funcional? ¿Puede sobrevivir una familia sin las cosas esenciales?

2. The teacher will then pass out the questionnaire to students and give them 15 minutes to complete it.
3. After students finish completing the questionnaire, the teacher will guide students into the following questions. The following explanation will help redirect the discussion to show that cells function in a similar pattern. The teacher will summarize what was discussed during the preview.

   Así como una familia tiene cosas esenciales, también tienen la célula. La célula no puede funcionar sin DNA. Un organismo no puede desarrollar, reproducir ni puede sobrevivir si la célula no usa el DNA que lleva. Como previamente mencionado, cada organelle juega un papel importante en la sobre vivencia de una célula, la llave para la sobre vivencia viene de DNA. La célula necesita ser capaz de leer el DNA para hacer energía.
4. Introduce key vocabulary:
   - DNA, RNA, mRNA, tRNA, nucleotide, molecules, protein, gene, codon, anti-codon, amino acid, transcription, translation, peptide bond and chemical energy (see provided Unit I power point slide show).

View (English) Lesson 2: (Estimated time 1 hour and 20 minutes) Sheltered Instruction

Reading the Genetic Code in the Nucleus

Procedure: Teacher explains throughout the simulation the following information (Use provided Unit I power point slide show to help facilitate the instruction of the following):

1. Introduction: Use the following information in conjunction with the provided Unit I power point slide show to explain the given information.

   Now that some cellular energy has been stored in ATP molecules, the next stop is the nucleus, where a message will be created that can be sent out to direct the creation of a protein.

   The DNA always remains in the nucleus, protected by the nuclear membrane (except during cell division). The genetic "blueprints" for any protein are found encoded in genes, which are sections of the DNA. DNA is a nucleic acid and is composed of four types of molecules called nucleotides. We often use letters to represent the four different types of nucleotide molecules.

   A=adenine

T=thymine
C=cytosine
G=guanine

RNA is also a nucleic acid and are made of a long chain of nucleotides. However, RNA does not contain thymine (T); it contains uracil (U), a similar nucleotide, instead.

One type of RNA is called messenger RNA (mRNA). It is a copy of a DNA gene and it is made in the nucleus. The process of copying a DNA gene into mRNA is called transcription. Unlike DNA, mRNA moves out of the nucleus into the cytoplasm, where it directs the creation of a specific protein.

Procedure: The teacher will demonstrate the following

2. Introduce activity: Steps students will follow during the simulation

   A. *A section of a DNA gene, 30 nucleotides long, is shown in Figure 3 in Appendix A. It has been split in half to fit on the page. Player 2 (RNA polymerase enzyme) reads the DNA gene shown in Figure 3 in Appendix A, and transcribes it into a mRNA message.*

   B. *The mRNA is not identical to the DNA; it is complementary. This is almost like translating the DNA into a code which is written in the mRNA. Figure 4 in Appendix A, gives the rules for converting the language of DNA into the language of mRNA.*

   C. *Player 2 starts reading the DNA in Figure 3 in Appendix A and then writes the complementary letter in the mRNA row below the DNA row. The first three nucleotides in Figure 3 in Appendix A have been transcribed for you.*

   D. *When transcription is finished, Player 2 cuts out the newly formed strip of mRNA from the page (leaving the DNA strip behind), and tapes the two pieces together at the center to form one continuous strip. The strip is moved out of the nucleus over to the ribosome, where it will direct the synthesis of a protein. Your group only needs one copy of mRNA for the simulation.*

      Look at the mRNA model you made with your group. Notice how the strip is separated into sequences of three nucleotides; these are called codons. Codons are like words; they call for one amino acid to be linked into a growing protein chain.

   E. *We will use only four different types of codons for our simulation. These codons specify one of four kinds of amino acids (gumdrops) to be placed in the protein model. Table 4 shows which gumdrop each of these four codons specifies. (In real cells the mRNA contains 64 different codons.)*

Table 4. Codons and their corresponding tRNAs and "amino acids"

mRNA Codons	tRNA	"Amino Acid"
UUG	green pipe cleaner	green gumdrop
CAG	yellow pipe cleaner	yellow gumdrop
GAA	white pipe cleaner	white gumdrop
GCA	red pipe cleaner	red gumdrop

F. *The mRNA contains ten codons of four different types. On the mRNA model, directly below each codon (in the bottom row labeled "AA" in Figure 3 in Appendix A).*

G. *Player 4 indicates which amino acid (gumdrop) is to be incorporated into the protein chain using Table 4. The first amino acid has been indicated in the mRNA model for you.*

Preparing tRNAs for Protein Synthesis

Procedure: The teacher explains throughout the simulation the following information (Use the provided Unit I power point slide show to help facilitate the instruction of the following):

3. Introduction: Use the following information in conjunction with the provided Unit I power point slide show to explain the given information.

   The function of tRNA is to pick up amino acids in the cytoplasm and to align them on the ribosome in the order specified by the mRNA. Each type of tRNA molecule carries only one specific kind of amino acid. At one end of the tRNA molecule is a site where the amino acid is attached. On the other end is a complementary site called an anticodon which can recognize a specific mRNA codon.

   A. *Player 3 makes four different-colored tRNA models which can carry the four types of amino acids to the ribosome. Player 3 bends four colored pipe cleaners into the "cloverleaf" shape shown in Figure 4. This is approximately the shape of all tRNA molecules in cells, (although each type has a different sequence of nucleotides).*

Figure 4:

Pipe Cleaner tRNA model

B. *An amino acid (gumdrop) matching the color of the tRNA is attached by sticking the sharp end of the pipe cleaner into the gumdrop. (Note: only tRNAs and amino acids of the same color are attached together!).*

Review (Spanish) Lesson 2: Questions and activity are found at the end of lesson 2.

Assessment
Self-Assessment through learning logs (or KWL charts) Individual report form, which asks students to draw a picture explaining the process of transcription. Number and label each step. Prompt for writing: "Explain to another student the process/steps of translation" (Student writes 3-4 sentences explaining process) (O'Malley & Pierce, 1996).

Instructional Activity

Lesson 2 Contd.

View (English): Sheltered Instruction

Protein Synthesis on the Ribosome

Procedure: The teacher will demonstrate the following

1. Introduce activity: Steps students will follow during the simulation

A. *The final step of protein synthesis requires the cooperation of both Player 3 (transfer RNA manager) and Player 4 (ribosome). Player 3 should have the pipe cleaners, toothpicks, and gumdrops nearby.*

A ribosome directs the creation of protein molecules. What are the subunits of proteins? (Use provided Unit I power point slide show to help explain protein composition)

Proteins are polymers (long chains) composed of amino acids. One protein differs from the rest in the length of the protein chain and the particular order and type of amino acids included in it.

B. *Examine the ribosome model, noting its two distinct regions (Figure 5). One holds the strip of mRNA, moving along it three nucleotides at a time. The other region has two sites which can hold tRNA molecules.*

Figure 5:
Ribosome model

C. *Player 4 cuts along the dotted lines in the two mRNA binding regions*

D. *Player 4 (ribosome) begins at the left-most codon on the mRNA strip. Slide the ribosome onto the mRNA strip. Notice that the mRNA binding region of the ribosome shows two codons through the cut-outs. Player 3 determines which tRNA + amino acid should be shuttled to the mRNA to begin the protein chain, and hands it to Player 4. Player 4 lines the appropriate tRNA up with the first mRNA codon in the first site on the ribosome. Player 3 then reads the second codon and identifies the second tRNA + amino acid and hands it to Player 4. Player 4 lines it up with the second mRNA codon in the second site on the ribosome (see Fig. 6).*

Figure 6:
Beginning protein synthesis

A peptide bond is formed between the two amino acids which are held side by side on the ribosome (Use provided Unit I power point slide show in conjunction with the following information to better explain the content).

E. *Player 4 breaks a toothpick in half and uses it to link the two gumdrops together. At the same time the peptide bond is formed, Player 3 breaks the bond between the first amino acid and its tRNA molecule by removing the end of the green pipe cleaner from the green gumdrop.*

The formation of a peptide bond requires an input of chemical energy (See figures 7). From where might chemical energy which has been stored in the cell be obtained?

The ATP molecules have been created with the energy released from the breaking of the bonds of glucose molecules (cookies). The bonds in ATP contain chemical energy which can be used to drive the attachment reaction. ATP molecules are found in the cytoplasm.

Figure 7:
Peptide bond formation

The chocolate kiss represents the stored energy in the ATP molecule and it is eaten or set aside as the energy is consumed to create a peptide bond.
**In reality, in your cells, the stored energy from a total of four ATP molecules is required to form each peptide bond.*

F. *Player 4 moves the ribosome down the strip of mRNA so that the second codon is now in the first ribosome site.*
G. *The tRNA attached to the small amino acid chain moves from the second binding site to the first binding site when the ribosome moves along the mRNA strip.*
H. *Player 3 moves the "empty" tRNA back to the cytoplasm and "recharges it" (by attaching another amino acid of the same color). This recharged tRNA will later carry another amino acid to the ribosome. See figure 8 tRNA leaves, ribosome moves ahead one codon.*
I. *Player 3 determines which tRNA with attached amino acid corresponds to the third mRNA codon and brings it into position. See figure 9,, new tRNA enters ribosome.*
J. *Player 4 then links the third amino acid to the second with a peptide bond (toothpick) and simultaneously releases the white tRNA attached to the second amino acid. See Figure 10, second peptide bonds.*

Figure 8:
tRNA leaves, ribosome moves ahead one codon.

Figure 9:
New tRNA enters ribosome.

Figure 10:
Second peptide bonds

Assessment

Self-Assessment through learning logs (or KWL charts)
Group report form: Group will draw out the process of cellular respiration, transcription, translation and protein synthesis. Group will also label and explain each step (Can also be individual assessment) (O'Malley & Pierce, 1996).

Review (Spanish) Lesson 2: (Estimated time 50 minutes)

Materials Needed:

1. Number of strawberries depends on class size (students will work in pairs)
2. Liquid soap
3. Salt
4. Water (20 ml per pair of students)
5. One cheese cloth per pair of students
6. One small beaker per pair of students
7. One test tube per pair of students
8. Alcohol (Ethanol works best)
9. One stirring rod per pair of students

Procedure: Before beginning the review questions, students will try to extract DNA from a strawberry. This lab is conducted to try and help student visualize the structure of DNA and relate it to the exercises that were conducted in lesson 2 (This lab can also be conducted at the beginning of lesson 2).

1. Introduction: Before (or during) the lab the teacher will demonstrate the following steps.

   A. *Ponga una fresa en una bolsa de plástico*
   B. *Agregue una gota de jabón a la fresa.*
   C. *Agregue un pellizco de sal.*
   D. *Ponle un poquito de agua (no más de 20 Ml).*
   E. *Mezcla la cosas en la bolsa hasta que se hace una pulpa.*
   F. *Vierta la mezcla por la estopilla a una cubeta pequeña.*
   G. *Transfiera esto a una probeta.*
   H. *Vierta suavemente alcohol (ethanol es mejor) hacia abajo el lado de la probeta para formar una capa encima del filtre.*
   I. *Mira el DNA que forma en la comunica entre los líquidos.*
   J. *Suavemente mezcla con una barra conmovedora y agarra la DNA.*

2. Possible summary questions

   ¿Por qué usamos una fresa? ¿Qué objetivo juega el jabón? ¿Qué objetivo juega la sal? ¿Por qué lo trituran? ¿Qué objetivo juega el alcohol? ¿Cuál es una fuente buena del DNA en una persona? ¿En una persona cómo se diferenciaría el procedimiento? ¿Por qué?

3. After the summary questions, the teacher will then begin to redirect the discussion to show that the family functions in a similar pattern.

Procedure: Possible student questions to elicit class or group discussions. These questions can be given out as a questionnaire to each student.

1. Introduction: The teacher will develop a questionnaire containing the following possible questions so students can review the importance of the key players in a family:

   ¿Qué era las cosas esenciales de la familia que usted listó previamente? ¿Qué son las cosas esenciales de una célula y por qué piensas ellos son importantes? ¿En tu opinión puede llegar a ser una familia funcional si ha perdido a los jugadores claves? ¿Qué pasaría si los jugadores claves fueron recobrados?

2. The teacher will then pass out the questionnaire to students and give them 15 minutes to complete it.
3. After students finish completing the questionnaire, the teacher will guide students into the following questions. The following questions will help redirect the discussion to show that DNA plays a similar function as a key player in the cell.

   ¿Podría componerse una célula si fuera disfuncional? ¿Cómo crea una célula la energía para sobrevivir?

   La síntesis de la proteína es un proceso complejo que ocurre muy rápido. ¿La sucesión de aminoácidos en una proteína es determinada por información contenida en qué moléculas?

   Los ácidos nucleicos, DNA y el RNA, son las moléculas de información-conteniendo.

   Explique el flujo de información implicada en la síntesis de la proteína.

   La información se queda permanentemente en DNA. Se copia la DNA en el mRNA para que se pueda mover del núcleo. Los RNA de la transferencia "leen" el codons de mRNA igualando con anticodons complementario. Sesenta y uno del 64 codons en el código de mRNA para aminoácidos, y ellos requieren 61 tRNAs diferente. La información se puede resumir como en Figura 11.

Figure 11:
Transfer of information in the cell

¿Cómo es posible guardar toda la información necesitado para construir una vida, en moléculas que tienen apenas cuatro bases de nucleótido?

Las cuatro bases son como cartas de un alfabeto. Podemos escribir oraciones infinitos con nuestro alfabeto de inglés de 26 cartas. Una computadora puede engendrar el mismo número infinito de oraciones con un alfabeto de dos cartas compuestos de cero y de uno. Los seres vivas pueden alcanzar la misma proeza con un alfabeto de cuatro letras.

¿De dónde vienen todas las enzimas implicadas en la síntesis de la proteína?

Ellos son las proteínas y por lo tanto son hechos por el proceso de la síntesis de la proteína descrita en esta lección, utilizando información en los genes. Usted puede preguntarse cómo un huevo puede producir las

proteínas que necesita crecer y producir las proteínas. ¿De dónde vienen ellos si no hay las enzimas alrededor de participar en la síntesis de la proteína? El huevo fertilizado hereda realmente estas enzimas críticas directamente de la madre; ellos están en el citoplasma de la célula del huevo. ¡Así que realmente heredamos más de nuestras madres de otra manera que apenas DNA!

Transitional Activity
How does your family grow?

UNIT II

Molecular Basis of Heredity

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Molecular Basis of Heredity

Unit Essential Question:
When cells divide how and what do they pass on to the next cell?
Why don't all humans look alike?

Standard	Objective: Lesson 1
GLE 1.2.7	Describe the role of chromosomes in reproduction (i.e., parents pass on chromosomes, which contain genes, to their offspring). Describe the possible results from mutation in DNA (e.g., only mutations in sex cells can be passed to offspring; mutations in other cells can only be passed to descendant cells). Describe how organisms pass on genetic information via asexual life cycles (i.e., the replication of genes in asexual reproduction results in the same gene combinations in the offspring as those of the parent).

	Student Objectives: Lesson 1
SWBAT:	• Describe how cells reproduce themselves. • Explain how chromosomes are copied and distributed to each daughter cell in a precise way. • Describe the need for, and the mechanism of, conservation of hereditary material. • Be able to define and correctly use the following terms: allele, anaphase, chromosome replication, cytokinesis, diploid, DNA synthesis, gene, homologous chromosome, interphase, life cycle, metaphase, mitosis, prometaphase, prophase, replicated chromosomes, sister chromatids, spindle fibers, telophase, and unreplicated chromosomes.

Instructional Activity

Estimated Lesson Time for Lesson 1: **4 hours and 50 minutes**

Lesson 1

Before each lesson students are asked to write down what they know about the given topic in a learning log (or KWL chart). The questions students would be answering are: What did I know before the lesson? What did I learn? What was the same? What was different? How can I relate this information to my life?

Preview (Spanish): (Estimated time 40 minutes)

Activity Objectives: The teacher will list the following objectives on the board:

- Describe how cells reproduce themselves.
- Explain how chromosomes are copied and distributed to each daughter cell in a precise way.
- Describe the need for, and the mechanism of, conservation of hereditary material.

Procedure: Possible student questions for group or class discussions. These questions can be given to students as a questionnaire

1. Introduction: The teacher will develop a questionnaire containing the following possible questions so students can understand the importance of how a family grows and develops:

   ¿En tu opinión, qué piensas hace una familia crecer? ¿Por qué crece una familia? ¿Que tan grande puede una familia ponerse? ¿Puede una familia dejar de crecer? ¿Qué tan grande es tu familia? ¿Cuando tu familia aumenta qué piensas que pasas a la siguiente generación, como tu cultura, o idioma o tradiciones? ¿Piensas que algunas de estas cosas en tu lista serán perdidas? Ahora, intenta relacionar con tus células. Piensas que ya cuando son hechos ellos nunca pueden ser reproducidos? ¿Cómo es que seguimos desarrollando y creciendo?

2. The teacher will then pass out the questionnaire to students and give them 15 minutes to complete it.
3. After students finish completing the questionnaire, the teacher will guide students into the following questions. The following questions will help redirect the discussion to show that cells function in a similar pattern.
4. These questions will help the students identify or relate to a cell, in that the cell also grows and passes on information to the next cell. The following questions will help assess student knowledge about mitosis (See provided Unit II power point slide show for visual representation of mitosis).

¿Están las células vivas?

Sí, las células son las unidades más pequeñas de la vida. Ellos son juzgados para estar viviendo porque ellos son capaces de la respiración, la toma de alimento nutritivo, la liberación de materiales de desecho, la reproducción fiel de sí mismos, del movimiento, de la receptividad, y de otras características.

¿Cómo crece un humano de una sola célula fertilizada a un individuo que contiene mil millones de células?

Las células aumentan su número por un proceso llamado cytokinesis o división de célula. La división de célula es precedida por la división o la mitosis nucleares. La información genética del padre se reproduce precisamente en cada célula de hija, mientras la división de los otros componentes de la célula son más aproximadas.

¿Se parecen todas las células del cuerpo al uno al otro? ¿Hacen ellos los mismos trabajos?

Hay muchos tipos diferentes de células en el cuerpo que sirven diferentes funciones. Una célula del nervio, que realiza los mensajes eléctricos, se mira muy diferente de una célula de músculo, que se utiliza para mover alguna parte de nuestro cuerpo.

¿Contienen todas las células del cuerpo la misma información genética?

Todas las células en el cuerpo, con excepción del huevo y la esperma, tienen copias idénticas de la información genética de un individuo. Los genes diferentes se activan en tipos diferentes de célula.

¿Cómo es el cianotipo genético que usted es transmitido fielmente de una célula al próximo?

La transmisión fiel de la materia genética de una generación de la célula es alcanzado luego por réplica de DNA (en la interfase) y la división (la mitosis). Esta réplica y la división nucleares ocurren mil millones de tiempos cuando un humano crece y desarrolla, con gran fidelidad.

¿Cuánto tiempo lleva para una célula de padre para llegar a ser dos células de hija?

En humanos, las células dividen rápidamente, por ejemplo en la piel e intestino dividen como una vez por día. Otras células como el tejido de cerebro y nervio dividen raramente en un adulto.

5. Introduce key vocabulary (See provided Unit II power point slide show for visualization while explaining the following terms):
    - Mitosis, interphase, prophase, metaphase, anaphase, telophase, cytokenisis, chromosomes, homologous, daughter cells, centrioles, somatic cells, diploid cells, double helix and spindle fibers.
6. The teacher will conduct a brief summary of what was previously discussed in the preview through the following story (optional):

The Mitosis Story

En cualquier tipo de un skit hay un ajuste y caracteres. En este skit, el ajuste está en un anillo de lucha libre y los caracteres son los luchadores y una pequeña muchacha. Al principio alguien tiene que introducir (INTERFASE) el anillo para que el fósforo comience. Ahora, sabemos que todos los luchadores (PROPHASE) se ponen una cierta clase de ropa. En este fósforo, nuestros luchadores se visten para arriba como un X grande (un cromosoma condensado). Después de que aparezca el primer X-como luchador, se replica. Ahora, tenemos dos luchadores X-formados idénticos en el anillo. Estos dos luchadores se hacen frente en el centro (METAPHASE) del anillo e instalado la etapa para una lucha. Pues los 2 luchadores están listos para luchar, una pequeña muchacha nombrada Ana vino funcionando en el anillo para parar la lucha (ANAPHASE). Ella había aprendido que la gente civilizada no debe luchar; Así pues, ella piensa en romperse encima de la lucha. Ana trajo hacia fuera varias longitudes de cuerdas y las puso alrededor de los luchadores y comenzó a separarlos. Después de una lucha, ella separó a los luchadores X-formados. Ella se puso bastante feliz sobre lo que había hecho, y le llamó a su mamá para decirle sobre lo que ella hizo. Ahora cada uno sabe que un teléfono (TELOPHASE) parece - dos círculos conectan en el centro (dibuje esto en el tablero para los estudiantes). Después de la llamada telefónica, Ana esta realmente cansada y ella desea ir a casa. Ella consiguió en su bicicleta (CYTOKINESIS) y montó el hogar (las 2 ruedas de la bicicleta están separadas, como las nuevas células divididas).

7. Ask the students to relate the skit to the phases of mitosis. The students will need to describe the steps of mitosis in their student log.

<u>View (English) Lesson 1: (Estimated time 3 hours and 30 minutes)</u> Sheltered Instruction

Activity Objectives: The teacher will write the following on the board:

- Be able to define and correctly use the following terms: allele, anaphase, chromosome replication, cytokinesis, diploid, DNA synthesis, gene, homologous chromosome, interphase, life cycle, metaphase, mitosis, prometaphase, prophase, replicated chromosomes, sister chromatids, spindle fibers, telophase, and unreplicated chromosomes.

Procedure: After the preview the teacher can use the provided Unit II power point slide show to explain the content.

1. Introduction: After the preview in Spanish, continue the delivery of the core concepts in English, using sheltered instruction techniques (visual aids) to explain the following: (See provide Unit II power point slide show).

Cell Division

Your body is composed of more than a billion cells. Cells are continually dying, and new cells are continually being formed. An identical copy of your hereditary material is found in the nucleus of each and every somatic cell. A somatic cell is any cell in the body except for the reproductive cells in the reproductive system.

This genetic blueprint is organized into 46 chapters or parts known as chromosomes. It is estimated that, on average, each chromosome contains between one and two thousand genes. A gene contains the information for making a single protein or RNA product.

Every time a cell divides, each chromosome must be carefully replicated (copied) and then distributed to assure that each daughter cell gets a complete and accurate set of information. Thus, nuclear division includes successive processes of chromosome replication, separation, and distribution (see Figure 1).

Figure 1:
Chromosome Replication & Division

DNA synthesis occurs in the nucleus, producing an exact replica of every chromosome. A chromosome can be thought of as a very long DNA double helix. During replication, the double helix opens up and a new complementary strand is synthesized along each parent strand (Figure 2). This results in two identical DNA helices, each containing one original parent strand and one newly synthesized strand.

Figure 2:
DNA Replicating

DNA synthesis occurs during the S phase of interphase. Each cell goes through a regular life cycle, similar to the cycle of life in humans. Where we might call our stages infancy, childhood, adolescence, young adult, adult, and senior, the major cell stages are interphase, mitosis, and cytokinesis. Interphase is subdivided into G1 (growth 1), S (synthesis), and G2 (growth 2), and mitosis is divided into P (prophase), PM (prometaphase), M (metaphase), A (anaphase), and T (telophase). This is shown in Figure 3. Another way to illustrate this cycle is shown in Figure 4.

Figure 3:
Cell Cycle

Figure 4:
Cell Division

Instructional Activity

Lesson 1 Contd.

View (English): Sheltered Instruction contd.

Materials Needed:

1. 2 sets of white and 2 sets of red plastic knives, forks and spoons per group for chromosomes
2. 1 large (3 ft) length and two smaller lengths (1.5 ft) of yarn for nuclear membrane
3. White or brown paper per group
4. Scissors
5. String for spindle fibers
6. Small rubber bands for centromeres
7. Yarn that is longer and a different color to represent cell membrane

Procedure: Students will work in groups (depending on class size) for the following activity.

1. Introduction: Student instructions

   A. *Go through the entire process several times, with each group member taking a turn as the "explainer". Follow along with the procedure below for the first one or two turns, and perform the subsequent repetitions from memory. Answer the questions about each stage as you go along, and answer them each time you go through the process. Explain your answers in your own words and your own way -- don't recite them by rote memory.*

Activity:

B. *You will study mitosis in the Triffle, a mythical creature with six chromosomes that look like knives, forks, and spoons. You will work out each step of the*

process using paper for cells, yarn for membranes, string for spindle fibers, and plastic knives, forks and spoons for <CHROMOSOMES< b>.

2. The teacher will demonstrate the following steps to the students (during the activity or before):

   C. *Take one large piece of paper for your cell, and use one color yarn to show the nuclear membrane and a different color yarn to show the cell membrane.*
   D. *Begin with a cell and nucleus containing six chromosomes represented by two forks (one red & one white), two knives (one red & one white), and two spoons (one red & one white). This represents a diploid cell with three pairs of chromosomes (Figure 5).*

Figure 5.
Triffle Diploid Chromosome Set

3. Possible student questions (For clarification purposes the teacher can use the provided Unit II power point slide show):

   What does diploid mean?
   Diploid means that there are two copies of each chromosome in the cell. For humans, this means 22 pairs of autosomes (44 total) and 1 pair of sex chromosomes (2 total). Most higher organisms are diploid. One chromosome set is obtained from the female parent through the egg and the other chromosome set is inherited from the male parent through the sperm (or in plants, through the pollen).
   Are most human cells diploid?
   All human cells are diploid with the exception of sperm and egg cells. Sperm and egg cells, also known as gametes, are haploid. They only have one copy of each chromosome, or 23 chromosomes total.
   How many pairs of homologous chromosomes are present in the picture of a Triffle cell, figure 5?

There are 3 pairs of homologous chromosomes in the Triffle cell, one pair each of knives, forks, and spoons, or a total of 6 unreplicated chromosomes.

E. Students will draw a circle around each homologous pair of chromosomes in the picture, Figure 5. (Students should draw three circles. One should be around the two knives, another around the spoons, and a third around the forks).

Are the homologues, (a short name for homologous chromosomes) above paired with one another in the cell, or are they independent from one another?

The homologues are independent of one another. They do not pair with each other at any time during mitosis. Nonetheless, this idea (chromosome pairing) will be put forth frequently by students. They typically remember chromosome pairing from some previous study of meiosis, and they tend to 'see' replicated chromosomes as chromosome pairs.

Contrast gene and allele.

A gene is a section of DNA which will code for a particular product. An allele is an alternate form of that gene. For example, one allele of the hair color gene codes for a product which will make hair brown. Another allele of the hair color gene codes for a product which makes hair blonde. A different gene, this one for eye color, has an allele that codes for a product which makes eyes green. As another example, the ABO blood type is produced by a single gene with three alleles that code for A, B, or O. Any individual can receive two of these three alleles and so be blood type A, B, AB, or O.

Interphase and Chromosome Replication:

*Throughout interphase, the chromosomes are **extended** and are not visible in the light microscope (Figure 6). That is, the DNA is uncoiled. We cannot simulate this extended condition with the knives, forks, and spoons, so please imagine it.*

Figure 6:
Interphase

F. *Replicate each of the chromosomes in your Triffle nucleus, pretending they are extended at the time. Do this by obtaining six more chromosomes that match the set you already have.*

G. *Attach a red fork to your red fork, a white fork to your white fork, and so on with an elastic band (which will represent the centromere).*

In this process, each chromosome has essentially made an identical copy of itself. Your nucleus initially contained six unreplicated chromosomes, and now it contains six replicated chromosomes. The two identical copies of each chromosome, sister chromatids, remain attached at a point called the centromere (Figure 7).

Figure 7:
Chromosome Centromere

4. The teacher can explain the following utilizing the provided Unit II power point slide show:

What is a chromatid made of (protein, carbohydrate, lipid, and/or DNA)?
A chromatid is made of a very long double helix of DNA and the DNA is typically surrounded by histone proteins., especially during the condensed phase.

How does a sister chromatids differ from a chromosome?
A sister chromatid is one-half of a replicated chromosome. A replicated chromosome contains two identical DNA double helices held together at the centromere. They are sister chromatids until the centromere breaks, at which point they become independent daughter chromosomes.

What is the centromere?
The centromere is the site on the replicated chromosome where it's two sister chromatids are attached. It appears as a constriction with two chromosome arms above and below. The parent helix has replicated along its entire length except at the centromere.

Contrast extended and condensed chromosomes.
Condensed chromosomes are long pieces of DNA that are highly associated with and wrapped around protein. Condensation is necessary

for nuclear division. Extended chromosomes are long pieces of DNA that are uncoiled and largely free and cannot be seen clearly by the naked eye or with a light microscope.

Prophase & Prometaphase of Mitosis

Procedure: The teacher can explain the following information utilizing the provided figures and the Unit II power point slide show.

5. Introduction: Use these discussion questions while utilizing the provided Unit II power point slide show and the provided figures, to explain the following content.

In prophase, the replicated chromosomes condense and are visible (see figure 8). This is the first step into mitosis.

Figure 8:
Prophase

Are the two sister chromatids that are connected by a centromere identical to one another or do they contain different alleles? (Use Unit II power point slide show).

The two sister chromatids connected by a centromere are identical, barring The two copies arose through replication of a parent chromosome (Figure 2).

As noted above, these structures are called replicated chromosomes (or, in many books, simply chromosomes). Replicated chromosomes are quite different from the unreplicated chromosomes seen earlier. The description below compares replicated chromosomes to unreplicated ones.

(1) The amount of DNA in a replicated chromosome is two times the amount of DNA in an unreplicated chromosome

(2) The number of copies of each gene in a replicated chromosome is two times the number of copies in an unreplicated chromosome

(3) Each replicated chromosome contains two (insert number) complete copies of genetic information

(4) The copies of genetic information in each chromosome are identical (identical, homologous, or complementary)

Do you think that the homologous replicated chromosomes (the two pairs of knives, the two pairs of forks, and the two pairs of spoons) will pair with one another during mitosis?

There is no pairing of homologous chromosomes during mitosis. (It is often difficult to convince students that this is the case. Pairing of homologous chromosomes is essential for halving the chromosome number, which occurs in the production of egg and sperm, in a specialized process called meiosis).

How many sister chromatids are in your Triffle nucleus in prophase?

12

A diploid human cell contains 46 unreplicated chromosomes in early interphase. How many sister chromatids will be present in the human cell during prophase of mitosis?

92

Prometaphase:

In prometaphase, the nuclear membrane literally "disappears", which allows the rest of the mitotic events to occur.

H. *Remove the nuclear membrane from around the chromosomes in the nucleus of your cell.*

Spindle fibers form, emanating from two structures called centrioles that have migrated to opposite poles (ends) of the cell. Spindle fibers are assembled from protein microtubules.

I. *Put spindle fibers in your cell using pieces of string and draw the centrioles on the paper at the appropriate points.*
J. *Some of the spindle fibers attach to the replicated chromosomes at their centromeres (Figure 9).*

Figure 9:
Prometaphase

Metaphase & Anaphase of Mitosis:

In metaphase, replicated chromosomes are lined up on the metaphase plane (across the center of the cell) by the spindle fibers(Figure 10). Homologous chromosomes are independent of one another. That is, homologous replicated chromosomes such as the two sets of replicated spoons ARE NOT PAIRED.

Figure 10:
Metaphase

K. *Arrange your Triffle chromosomes across the center of the cell. The specific order of chromosomes and their orientation (right side up, upside down) is completely random.*

6. Introduction: Use these discussion questions while utilizing the provided Unit II power point slide show and the provided figures, to explain the following content.

How many replicated chromosomes are on the metaphase plane in the Triffle?
There are six replicated chromosomes in the cell, each with two chromatids held together at the centromere.
How many replicated chromosomes would be on the metaphase plane in a human cell undergoing mitosis?
There would be 46 replicated chromosomes in any human cell undergoing mitosis, with a total of 92 chromatids.

Anaphase:

In anaphase, sister chromatids separate to become daughter chromosomes (Figure 11).

Figure 11:
Anaphase

L. *Separate your sister chromatids to form daughter chromosomes.*

Daughter chromosomes are moved toward opposite poles by the spindle fibers. Chromatids are flexible. They do not remain rigid, but rather bend on each side of the centromere as they are dragged through the cytoplasm.

7. Use these discussion questions while utilizing the provided Unit II power point slide show and the provided figures, to explain the following content.

Are the daughter chromosomes replicated or unreplicated?
Daughter chromosomes are now unreplicated. Each contains a single DNA double helix.
Are the two sets of daughter chromosomes, the one moving toward the left and the other toward the right, identical or non-identical?
With the exception of rare mutation events, mitosis leads to the formation of identical daughter chromosomes. Many of the same questions are asked several times in several different circumstances because these seem to be difficult ideas for students to grasp.
Are the two sets of daughter chromosomes identical to those in the parent cell?
Yes! In fact, each daughter chromosome contains one parent strand of DNA with a newly synthesized complementary strand.
What is accomplished by this process?
In mitosis, the genetic information in the chromosomes of a cell is first reproduced precisely and then the duplicate sets of information are distributed precisely to two daughter cells preserving the original genetic blueprint.

Telophase & cytokenisis in Mitosis:

Daughter chromosomes reach the poles of the cell and become extended (relaxed). The spindle fibers actually disappear, the microtubulin subunits are disassembled.

M. *You can remove your spindle fibers from your cells and pretend your chromosomes are going into the extended state.*

Two new nuclear membranes form, one around each set of daughter chromosomes.

N. *Use the nuclear membrane yarn to create two new nuclear membranes in your cell (Figure 12). Pinch in the yarn representing the cell membrane.*

Figure 12:
Telophase

Cytokinesis:

An animal cell pinches in half at the center (Figure 12), from the outside in, until it has produced two separate daughter cells (Figure 13).

Figure 13:
Cytokinesis Completed

O. *Divide your cell in half in this manner by replacing the long yarn representing the parent cell membrane with two shorter pieces of yarn representing the membranes of the two daughter cells.*

These daughter cells are now entering the early interphase stage. Pretend that your Triffle chromosomes are becoming extended. The cells will grow to full size and, if continuing to divide, will replicate their chromosomes, and repeat the cycle again.

8. Use these discussion questions while utilizing the provided Unit II power point slide show and the provided figures, to explain the following content.

Does the parent cell still exist?

The parent cell no longer exists. It has divided into two. The cytoplasm and the organelles that were in the parent cell have been divided approximately in half into the two daughter cells.

How are these daughter cells related to one another?

The daughter cells are genetically identical and similar in morphology (size and shape) and function.

How are these daughter cells related to the parent cell?

The daughter cells are genetically identical to the parent cell, but they may be slightly different morphologically. If there is a morphological difference, it will be reflected in a slightly smaller cell size of one daughter and larger size of the other, since cytokinesis is not as precise as mitosis.

Activity: Cell division & Mitosis

Activity Objectives: The teacher will write the following on the board:

- Students will make a slide of onion root tips and observe different phases of mitosis.
- Students will draw the different stages of mitosis and try to arrange them in order of division.
- Students will demonstrate each phase of mitosis and the main characteristics of each.
- This activity was developed to help student visualize and relate to the phases of mitosis through an onion root tip. Most of the student exposure to mitosis comes from a text book. The following are directions to follow for the onion lab.

Teacher Materials:

1. Fresh grown onion root tip
2. 5-10ml distilled water, 5ml 6M HCl, 1 ml Feulgen reagent in a vial
3. 5 ml 45% acetic acid, dropper pipette per solution
4. Beaker, slide, coverslip, and a pencil with eraser or small cork to squash the slide.

Materials needed per class are:

1. 5-10 ml Carnoy's solution (1 glacial acetic acid : 3 absolute alcohol) in vial
2. 2-3 cups and onions, and toothpicks.
3. A microscope per student or pair.
4. Two different colored pipe cleaners cut at varied lengths to represent chromosomes for assessment (4 chromosomes per cell) (2 long and 2 short blue pipe cleaners and 2 long and 2 short red pipe cleaners connected with beads which represent the centromeres). This model would use the long pipe cleaners as a homologous pair of chromosomes and the short as another pair. Two pipe cleaners of each size and color are used to model replication. Each chromosome is composed of two chromatids.

Before day activity:

1. Take an ordinary yellow onion. Cut off any old root growth. Place the onion in a cup of water so that only the root portion is under water. To do this, push toothpicks into the side of the onion which extend outward and hold it on the rim of the cup. New roots should grow within two days.
2. Cut off .5-1 cm of growth at the root tip - enough for all the students.
3. Transfer immediately to Carnoy's solution. After 24 hours, roots should be stored in 70% ethanol in a refrigerator. This stops cell division.

Procedure for Activity:

1. Introduction: The teacher will demonstrate the following steps before the students begin the lab (students are paired or grouped together for the lab).

   A. *Students will Obtain a root tip.*
   B. *After obtaining the root tip, pour off the fixative and replace it with 2-5 ml distilled water. Solutions may be poured into a beaker or down the drain.*
   C. *After 1 minute remove the water with a pipette and add 2-5 ml 6M HCl.*
   D. *After 3 minutes carefully remove the acid and wash tissue off with distilled water. Agitate the vial for 1-2 minutes. Discard the water.*
   E. *Use forceps to transfer the tissue to a vial containing 1-2 ml Feulgen reagent. The reagent may be added to this vial if desired. (CAUTION: this dye will stain hands and clothes permanently.)*
   F. *After 20 minutes use forceps to transfer the tissue to a vial containing 5 ml 45% acetic acid.*
   G. *Place 1-2 drops of acetic acid onto a microscope slide and transfer the tissue to the drop. Using dissecting pins and razor blades tease and macerate the tissue into tiny pieces.*
   H. *Place a coverslip over the macerated tissue trying not to get air bubbles under the coverslip. Press down firmly onto the coverslip with a small cork or pencil eraser to spread the cells in a very thin layer. Push down in a perpendicular direction and the coverslip should not break.*

I. *Once the slide has been prepared, observe it and draw all the different views of cells present under high power. Observe the nucleus and the chromosomes.*

2. Possible student discussion questions during the 20 minute stain time (Step 6) (It is important to have the students discuss what the cells are doing).

   Since these cells are in the root tip, they are rapidly dividing. During normal cell activity the chromosomes are unwound and too thin to be seen. During cell division, chromosomes thicken, take up stain and can be easily observed

3. The students should also try to come up with reasons why cells divide possible answers: to grow, to repair or replace damaged cells, to reproduce, or to differentiate in the cell cycle of multicellular organisms. Also at this time explain what is happening in interphase. Cells need to replicate the chromosomes before dividing to ensure that the newly formed cells contain the same genetic material (chromosomes).

4. What the students are observing is an ordered process by which the cells divide the chromosomes so that one copy of each goes to each new cell.

5. Once they have drawn all the different views of cells they have observed, they should share them with their lab groups, the teacher and perhaps the class. Hopefully all the stages of mitosis have been observed and drawn.

6. These can be put on the board or overhead so that the entire class can see all the phases/views and copy them onto their papers. It is not necessary to name the observed cells with a phase of mitosis, but it may be easier so that students can more easily differentiate them and relate them to a new vocabulary term. Once all the students have drawings of all the phases of mitosis, ask them to arrange the pictures in a way which would show a logical sequence of cell division.

7. Have one member from each group explain what order they put the drawings and why they did it that way.

8. Students are to make a model of a cell which is in the process of mitosis and cell division. They should draw on their paper the border of a cell which is dividing. These need to be big enough so that the pipe cleaners can be put inside. There needs to be a cell border for interphase, prophase (one for early and late prophase), metaphase, a partially dividing cell for anaphase, a nearly totally divided cell for telophase, and two new cells for the daughter cells.

9. Students will take the pipe cleaners and place them in the "cells". They should arrange four "chromosomes" properly in the various phases of mitosis.

10. The pipe cleaners may be taped or glued on the paper and a description written which describes the events occurring within the cell. The pipe cleaners may be

manipulated and each phase described to the teacher (students summarize their work to the teacher).

Transitional Activity How do chromosomes relate to me?

Instructional Activity

Lesson 1 Contd.

View (English): Sheltered Instruction

Procedure: How do chromosomes relate to me?

1. Introduction: Ask the following questions to the students utilizing the provided Unit II power point slide show as a guide

   A. *Examine the chromosome spread in the top half of*
   B. *Figure 1 in Appendix B. How do you think such a picture is obtained?*
      A chromosome spread is made by:
      Arresting cells in metaphase of mitosis with a drug like colchicine putting a drop of these cells on a slide, covering with a cover slip, and pressing lightly to break cells open drying and staining the pressed cells with a stain taken up by chromosomes, then examining under a light microscope, and photographing with a light microscope.

   C. *Then examine the human karyotype in the bottom half of Figure 1 in Appendix B.*
      A karyotype is made by:
      Cutting the individual chromosomes from a photograph of a chromosome spread arranging the chromosomes in matched pairs from largest to smallest numbering the chromosome pairs

   D. *With your group, relate what you have learned in this lab to:*
      The growth and differentiation of tissues in babies,
      A baby begins with a single cell, an egg from its mother that has been fertilized by a sperm from its father. These two cells each bring in one haploid set of chromosomes that are united in a single nucleus in the fertilized egg. The fertilized egg divides by mitosis and mitotic cell division is repeated millions of times as the baby develops. At various points in the process, daughter cells differentiate to form specialized tissues. This is accomplished through regulation and differential expression of genes in different cell types.

The use of a somatic cell rather than sperm and egg to create a new organism such as a sheep or frog,

The fact that an entire new organism can develop from a diploid somatic (body) cell as well as from the union of two specialized haploid germ cells is pretty remarkable. Of course, this only happens under very specialized experimental conditions. The organism that is formed in this way will be genetically identical to the parent cell and to the individual from which that parent cell was taken, rather than being a blend of two parents. For this reason it is called a clone.

Another related phenomenon of your own choosing.

Review (Spanish): Located at the end of Lesson 1

Assessment
Students are assessed through the learning log (or KWL charts)
Teacher Observation Checklist: See Figure 2 in Appendix B (O'Malley & Pierce, 1996)

Review (Spanish): (Estimated time 40 minutes)

Procedure: Possible student questions to elicit class or group discussions. These questions can be given out as a questionnaire to each student.

1. Introduction: The teacher will develop a questionnaire containing the following possible questions so students can review the importance of how a family can grow:

   ¿Cuando usted mencionó previamente, cómo crece una familia? ¿Cuales son las posibilidades diferentes que piensas pueden permitir una familia crecer? ¿Qué listó usted que era esencial para pasar a la próxima generación? ¿Por qué piensas que es importante para una familia crecer?
2. The teacher will then pass out the questionnaire to students and give them 10 minutes to complete it.
3. After students finish completing the questionnaire, the teacher will guide students into the following questions. The following questions will help summarize and redirect the discussion to show that cellular growth along with DNA plays a similar function in the cell (Refer back to provided Unit II power point slide show to provide clarification as needed).

   ¿Qué es la mejor descripción de cromosomas homólogas? (Escoja la mejor respuesta)

   (1) ellos tienen el mismo tamaño y forma
   (2) ellos contienen los mismos tipos de genes en la misma orden
   (3) ellos contienen generalmente las versiones diferentes (alleles) de muchos de genes
   (4) todo los de encima son la mejor respuesta
   La respuesta es 4. Todas estas declaraciones son verdad de cromosomas homólogas.

   Defina el cromosoma homóloga.

   Un organismo diploid, tal como un humano, tiene dos de cada clase del cromosoma, uno de su padre y uno de su madre. Los cromosomas homólogas tienen el tamaño y la forma semejantes, y ellos llevan los mismos genes arreglados en la misma orden. Sin embargo la versión particular (allele) de cada gene no puede ser el mismo en los dos cromosomas homólogas.

   Por ejemplo, acerca el par homóloga de cromosomas de cuchillo, digamos que uno de los cuchillos tiene un gene que codifica para el color marrón de pelo. El otro cromosoma del cuchillo, mientras poseyendo todavía el gene para el color de pelo, puede codificar para el color rubio de pelo.

¿En términos generales, qué ha sido alcanzado por la mitosis?

Dos cosas se han alcanzado. La mitosis a resultado en un duplicar del número de la célula, y también efectivamente y exactamente pasos por la materia genética a la próxima generación. Usted ha utilizado sus materias para modelar la mitosis (la división nuclear) y la división celular.

Explique algunas maneras en las que un modelo difiere de las cosas verdaderas y lo que el procesa representa.

Nuestro modelo de una célula, es hecho de papel, y de nuestros modelos de cromosomas, hecho del cubiertos, son las representaciones crudas de las cosas verdaderas. Ellos nos permiten representa y manipular de otro modo objetos microscópicos. Sin embargo, es importante estar enterado que las cosas y los procesos verdaderos son bastante diferentes de los modelos, por eso tienen que estar atentos de ésas diferencias. Ayuda también a recordar que algunos aspectos del modelo, tal como la incapacidad para ilustrar la transición de condensado a estados prolongados con cubiertos, puede ser descaminando.

Activity:

- *Como notado arriba, usted puede atravesar el proceso entero varias veces, con cada miembro del grupo tomando una vuelta como el "dilucidador". Siga los procedimientos resumido arriba por uno o dos vueltas, y entonces realice las repeticiones subsiguientes de la memoria. Usted puede referirse a la tabla 1 para una guía, y sus compañeros del equipo te pueden ayudar por haciendo preguntas.*

- Cell Cycle Summary:

Interfase G1
El Crecimiento y el desarrollo de la síntesis de la Proteína de la célula

S-Fase
La réplica del Cromosoma vía la síntesis de DNA

G2
El Crecimiento del teatro & Réplica de desarrollo Organelle

<u>Mitosis</u>
La profase Replicó los cromosomas condensan
Prometaphase membrana Nuclear se disuelve y fibras de eje forman
Metafase los cromosomas Replicados alinean en el centro
Anafase los cromosomas de hijas se separan a diferentes partes
Telofase nuevas membranas nucleares forman
Fibras de Eje desaparecen
Cytokinesis la Célula se divide en dos células de hija

Assessment

Students are assessed through the learning log (or KWL charts)
Group report form: Group will draw out phase/s covered while answering given questions. Group will label and explain each step of the drawing. Peers will evaluate each other while reviewing the process of mitosis
(Can also be individual assessment) (O'Malley & Pierce, 1996)

Transitional Activity

What happens after we put some, many and a lot of cells together?

UNIT III

Human Body Systems

Contents | Page

HUMAN BODY SYSTEMS

Unit Essential Question
How do our systems function to survive?

Standard	Objective: Lesson 1
GLE 1.2.8	Students will be able to name the structural and functional characteristics of human body systems, how the human body maintains constant internal conditions and human growth and development

	Student Objectives: Lesson 1
SWBAT:	• Explain the function of different types of muscle tissue, their function and where they are located • Explain the process of respiration, the functions of organs involved and where they are located • Explain the process of digestion, functions of organs involved and where they are located

Instructional Activity

Estimated Lesson Time for Lesson 1: **4 hours**

Lesson 1

Before each lesson students are asked to write down what they know about the given topic in a learning log (or KWL chart). The questions students would be answering are: What did I know before the lesson? What did I learn? What was the same? What was different? How can I relate this information to my life?

Preview (Spanish): (Estimated time 30 minutes)

Activity Objectives: The teacher will write the following objectives on the board:

- Explain the function of different types of muscle tissue, their function and where they are located

Materials Needed:

Making a gel person

1. Unflavored gelatin (.25 Oz. Envelopes)
2. Blue food coloring (optional)
3. Gel person mold (gingerbread man)
4. Pasta (assorted shapes & sizes, cooked)
5. Vegetables (beans, cauliflower, cooked)
6. Tray or plate

*materials will make two GEL Persons

Visualization of scanning imaging

1. Gel person
2. Plastic or glass (4" x 6")
3. Ring stand or bracket (optional)
4. Flashlight or small lamp
5. White card (8.5" x 11")

Procedure: The students will create their own "human gel person," to help visualize the organs in a human body.

1. Introduction to Activity: The following can be an example of a lab in which students can relate to the major organs in the human body. This lab is used to help students visualize human organs, but also to help lead into the following lesson.

Gel Person:

2. Before students create their own "Gel person" the teacher will demonstrate the following steps:

   A. *Obtiene dos moldes de gelatina en la forma de una persona.*
   B. *Mezcla dos sobres de la gelatina no condimentada en 1.25 tazas de agua hirviente hasta que se desbarata. Añada una gota de colorante de alimento. Esto dará un poco de contraste para "los órganos" dentro de la persona de gel, sin perder demasiada transparencia.*

C. *Ponle bastante solución de gelatina caliente en el fondo del molde para cubrir sólo el fondo (la superficie anterior de la persona). Póngalo en un refrigerador hasta que se cuaje (aproximadamente 30 minutos). Ponga el restante aparte hasta el Step E.*

D. *Ponga la Pasta y verduras en el molde encima del gel.*

E. *Usa un pequeño florete de la coliflor cocinada en la cabeza (para imitar el cerebro). En el resto del cuerpo, use a algunos o todos de éstos:*
   - *Varios pedazos de pequeños macarrones de codo cocinados (para imitar órganos huecos).*
   - *Un pedazo de mostaccioli cocinado rigati (para imitar un órgano hueco y grande con una superficie irregular).*
   - *2 o 3 canadas rojas de fríjol (para imitar órganos sólidos como los riñones).*
   - *Un hilo corto de vermicelli cocinados (para imitar órganos parecidos a una fibra sólidos como nervios). Usted podría enrollar un pedazo de esto para mostrar como los órganos enrollados se revelan en una sección transversal.*

F. *No usan demasiados pedazos. Extiende las cosas un poco. Usted puede también poner los "órganos" en las armas y piernas así como la parte media del cuerpo.*

G. *Llena el molde a la cumbre con la solución de gelatina restante. Refrigeralo hasta que se ponga sólido (aproximadamente 30 minutos).*

H. *Quita el molde del refrigerador y ponlo en el agua caliente por unos segundos para sueltar la gelatina. Coloque una bandeja o el plato sobre el molde e invierta, dejando caer la forma de gelatina en la bandeja. Use a la persona de gel rápidamente. Las personas de gel pueden ser refrigeradas pero no se congelan bien.*

Scanning Imaging:

I. *Coloca a la persona de gel en una 4" X 6" plato de vidrio o acrílico transparente.*

J. *Sujete el plato (con la persona de gel adentro) al soporte del anillo. En vez de utilizar un soporte de abrazadera y anillo, usted puede tener simplemente a un voluntario que lo puede detener.*

K. *Utilice una linterna o la lámpara para lanzar una sombra en la tarjeta blanca. Haga esto con teniendo la fuente ligera encima de la persona de gel y la tarjeta blanca debajo del plato transparente. Esto demuestra el principio de la fotografía uniforme de radiografía.*

L. *Teniendo la fuente ligera en una mano y la tarjeta blanca en el otro, gira el par alrededor de la persona de gel sin cambiar la distancia o el ángulo de manos. Esto imita la acción de un escáner axial utilizado en crear CT escudriña.*

3. Discuss how a scanned image can produce a 3D image of the contents of the body or of an individual organ.
4. After students have completed the lab, the teacher will discuss the importance of organs and organ systems and will re-direct the discussion towards family and community roles as a whole, utilizing the following procedure.

Procedure: Possible student questions to elicit class or group discussions. These questions can be given out as a questionnaire to each student.

1. Introduction: The teacher will develop a questionnaire containing the following possible questions so students can understand the importance of the key players as a whole:

   Si usted puede recordar, hemos estado hablando acerca de los jugadores claves en una comunidad y una familia. Ahora les quiero preguntar cómo una comunidad y una familia funcionan como entero para ayudar a crear una mejor sociedad.

   ¿Qué es una sociedad? ¿Qué determina si una sociedad es buena o mala? ¿Qué son algunos beneficios de tener una sociedad buena? ¿Qué son algunos aspectos negativos de tener una sociedad buena? ¿Cómo como individuos jugamos nosotros en el desarrollo de una sociedad? ¿Qué podemos hacer para mejorar una sociedad?
2. The teacher will then pass out the questionnaire to students and give them 15 minutes to complete it.
3. After students finish completing the questionnaire, the teacher will guide students into the following questions. The following questions will help redirect the discussion to show that the human body functions in a similar pattern.
4. These questions will help the students identify or relate to the human body, in that the human body cannot function correctly without its systems. The following questions will help assess student knowledge about the human body.

   Así como una sociedad puede ser realizada por muchos aspectos diferentes (que discutimos), también puede el cuerpo. El cuerpo tiene ocho sistemas diferentes del cuerpo que ayudan el cuerpo humano sobrevivir. Estaremos discutiendo tres de ellos, que incluyeron el sistema muscular, el sistema respiratorio y el aparato digestivo. Estos sistemas juntos con los otros cinco son esenciales en mantener la salud humana. Cada sistema tiene órganos específicos que ayuda a regular su función, sin estos órganos trabajando correctamente el cuerpo humano no puede funcionar a su potencial.
5. Introduce key vocabulary utilizing provided Unit III power point slide show:
   - Organ, body systems, muscle, smooth muscle, skeletal muscle, cardiac muscle, lungs, diaphragm, heart, pancreas, stomach, small intestines and large intestine.

View (English) Lesson 1: (Estimated time 2 hours and 30 minutes) Sheltered Instruction

Muscular System

Materials Needed:
1. Human Demonstration Model (plastic)

2. KWL Chart (can be drawn on board)
3. Muscle hand out

Procedure: The teacher will ask informal questions to the students concerning muscle tissue utilizing a KWL chart. The teacher will ask students what they believe the functions of the muscular system are, where they are located and to give some examples utilizing the following questions.

1. Introduction: During the production of the KWL chart, the teacher will be able to identify what the students already know and what areas may need clarification.

   What are muscles? Why do we need muscles? Where do you believe the most important muscles are located and why? Are their other types of muscles and where are they located?

2. The teacher will then begin explaining the muscle system, with help from the human demonstration model. The teacher will hold up an organ, which belongs to the smooth muscle category (ex. Liver, pancreas, or intestines), to the class.

3. The teacher will then point to a skeletal muscle (already on the human demonstration model), and ask the following:

   What differences are their between the smooth muscle and the skeletal muscle? Such as where they are located, and why they are located in that particular area. What do you believe is the function of the skeletal muscle and smooth muscle?

4. The teacher will continue to do this while explaining the differences between each of the three types of muscle including the cardiac muscle (utilize provided Unit IV power point slide show to help students visualize the muscle system).

<u>*Cardiac muscle*</u>

Cardiac muscle is only in the heart and makes up the atria and ventricles (heart walls). Like skeletal muscle, cardiac muscle contains striated fibers. Cardiac muscle is called involuntary muscle because conscious thought does not control its contractions. Specialized cardiac muscle cells maintain a consistent heart rate.

<u>*Smooth muscle*</u>

Smooth muscle is throughout the body, including in visceral (internal) organs, blood vessels, and glands. Like cardiac muscle, smooth muscle is involuntary. Unlike skeletal and cardiac muscle, smooth muscle is non-striated (not banded). Smooth muscle, which is extensively within the walls of digestive tract organs, causes peristalsis (wave-like contractions) that aids in food digestion and transport. Except the heart, any action that the body performs without conscious thought is done by smooth muscle contractions. This includes diverse activities such as constricting (closing) the bronchioles (air passages) of the lungs or pupils of the eye or causing goose bumps in cold conditions.

Skeletal muscle

A skeletal muscle has regular, ordered groups of fascicles, muscle fibers, myofibrils, and myofilaments. Epimysium (thick connective tissue) binds groups of fascicles together. A fascicle has muscle fibers; perimysium (connective tissue) envelops the fascicle. Endomysium (connective tissue) surrounds the muscle fibers. A muscle fiber divides into even smaller parts. Within each fiber are strands of myofibrils. These long cylindrical structures appear striped due to strands of tiny myofilaments. Myofilaments have two types of protein: actin (thin myofilaments) and myosin (thick myofilaments).

5. Students will fill out the provided handout of 10 major muscles of the body, see Figure 1 in Appendix C and explain why each of the indicated muscles are important (separate sheet of paper). Figure 1 in Appendix C is an example of some major muscles; the teacher can modify the figure as needed.
6. Students will be able to associate the muscle to the picture, according to the labels next to them. The teacher will observe the students as they work together or individually on the handout.
7. After the activity, the teacher will finish filling out the KWL chart with the help of the students.

Assessment

Students are assessed through the learning log (or KWL charts)

Prompt for writing: "Explain to another student the types of muscle tissue, where they are located and their function." Student writes 3-4 sentences explaining process (Sample T-List may also be used, see figure 3) (O'Malley & Pierce (1996).

Transitional Activity

What kinds of muscles do we use to breath?

Instructional Activity

Lesson 1 Contd.

The respiratory system

Activity Objectives: The teacher will write the following objectives on the board:

- Explain the process of respiration, the functions of organs involved and where they are located

Materials Needed:

1. Body handout
2. Human demonstration model (plastic)
3. Candle, matches, clear cup or glass
4. Water, tape
5. 2-pieces of straw, 2-small balloons
6. Pan, rubber cement
7. 1-large balloon, rubber bands - 2 small, 1 large

Procedure: The teacher will use the following questions in conjunction with the demonstrations to illustrate how the respiratory system functions.

1. Introduction: The teacher will ask students the following possible questions:

   What happens to your chest when you breathe and exhale? Why does your chest expand? What organ do you think is responsible for this action? Do you know what organs are associated with breathing? The respiratory system is responsible for helping us breath. The respiratory system is composed of different organs that have a specific function to help us breath and exhale. Point to where the lungs are located on the human demonstration model.
2. The teacher will ask students to take a deep breath, during this process the students should feel their rib cage is expanding. Ask the following questions to continue with the discussion.

   What does it mean to breath? Why do we breathe? What do we breath and what do we exhale? Why do we exhale?
3. The teacher will continue to ask students to point out which organs they believe to be associated with the respiratory system (Utilize provided Unit III power point slide show for more visualization of process of respiration).

   The lungs are paired organs that lie on either side of the heart and fill up the thoracic (chest) cavity. Below the lungs is the diaphragm, a broad thin muscle that separates the thoracic cavity from the abdominal (gut) cavity. On the inner surface of each lung is the hilus, where blood vessels, nerves, and bronchi (air passages) enter the lungs.

   Air enters the body through the mouth or nose. In the nose, thick hairs lining the nostrils prevent small objects from entering the nasal cavity. This cavity is lined with cells that produce mucus. Small foreign matter that enters the nasal cavities is trapped in the mucus, while tiny cilia (small hair-like projections) push the mucus to the pharynx (throat), where it is swallowed and digested in the stomach or expectorated.

   From the pharynx, the air passes to the larynx, which is called the voice box because it contains the vocal cords. To prevent food or liquid from entering the larynx, the epiglottis (a small flap of tissue) closes over the opening of the larynx

during deglutition (swallowing). If this process works improperly, a cough reflex expels the foreign material.

When air travels past the larynx, it enters the trachea (windpipe). The trachea is a strong tube containing rings of cartilage that prevents it from collapsing. The mucosa that lines the airway warms and moistens the air before it reaches the trachea. Within the lungs, the trachea branches into a left and right bronchus, which divide into increasingly smaller branches called bronchioles. The smallest bronchioles end in a cluster of air sacs, collectively called acinus. The acinus comprises individual air sacs called alveoli. Alveoli are like small balloons that inflate and deflate with air during respiration.

Gas exchange occurs in the lungs between the alveoli and a capillary network within the alveolar wall. Capillaries are microscopic blood vessels that exchange material between the blood and body tissues. In the lung capillaries, blood from tissues where cellular metabolism is occurring is called deoxygenated blood because it contains many carbon dioxide molecules and few oxygen molecules.

4. As the teacher discusses with the class, he/she will show there is oxygen present in the air we breath through the following demonstration:

    A. Place a small amount of water in the bottom of the pan, enough to cover the bottom of the pan.
    B. Light the candle and place in the water on the bottom of the pan.
    C. Cover the lit candle with the glass and observe what happens to the water.

5. The teacher would then ask the following possible questions to bring clarification and to summarize the demonstration.

    What will happen or what is happening and why? What are the chief functions of the respiratory system? Why do we need to breathe? What's in the air we breathe? How do you know there is oxygen in the air we breathe? What would happen if your oxygen ran out?

Procedure: Students will construct an experiment of the action the diaphragm has in respiration. This experiment will allow students to have hands on experience but to also help them visualize the process of respiration more clearly. Students are grouped or paired together during this lab.

1. Introduction: The teacher will first demonstrate the following steps before allowing students to proceed.

    A. *Take a piece of straw about 2 inches in length and cut a small triangle in the center, but don't go through to the opposite side. Fit one small balloon over each end of the straw and secure it with a small rubber band. (Make sure that air will go into each balloon when blown from the top.)*

B. *Bend the straw in the middle of the hole.*
C. *Take a second piece of straw and cut a V-shape on the end. Fit the slanted points of the straw into each semi-circle of the hole of the bent straw.*
D. *Cement the two pieces of the straw together. Allow to dry or use tape to hold until dry.*
E. *Cut a hole in the bottom of the clear plastic cup using the diameter of the straw as a guide to the size. Push the open end of the straw into the hole of the plastic cup from the inside. Cement the straw into the hole.*
F. *Take the large balloon and cut the neck off. Carefully stretch the cut balloon over the opening of the cup. Do not crack the cup. Secure the edges with the large rubber band. Do not cement the sides of the cup. The model will only work if there are no leaks.*
G. *Then pull the bottom balloon gently and observe what happens to the small balloons.*

2. The teacher will then ask the students the following possible questions to help summarize both the lab and the respiratory system.

   What happened to the balloons, explain your reasoning? What do the small balloons represent? What do the two ends of the straw to which the balloons are attached represent? What does the longer piece of straw represent? What do the sides of the cup represent? What does the balloon sheet over the cup's opening represent? What happened to the small balloons when you pulled down on the balloon sheet? What happened to the small balloons when you push up on the balloon sheet? What happens to the air once it's in the lungs?

Review (Spanish): Review is found at the end of lesson 1

Assessment
Students are assessed through the learning log (or KWL charts)
T-List, see figure 4 in Appendix C (O'Malley & Pierce, 1996).

Transitional Activity
How does our body extract energy from food?

Instructional Activity

Lesson 1 contd.

View (English) Lesson 1 contd.: Sheltered Instruction

Activity Objective: The teacher will write the following objective on the board:
- Explain the process of digestion, functions of organs involved and where they are located

Materials Needed:

1. Body handout
2. Pencils
3. Video (CWU)
4. Human demonstration model
5. 9 meter rope
6. Digestive system story

Procedure: The teacher will first begin the class by enthusiastically reading a short story about the digestive system.

1. Introduction: As the teacher read the short story he/she will be giving real life examples and utilizing the human demonstration model when organs come up in the story. The short story can be obtained at the following website

   http://yucky.kids.discovery.com/noflash/body/pg000123.html

2. After the teacher has read the short story and grabbed student's attention, the teacher will review the process of digestion and the functions of the participating organs utilizing the human demonstration model (students are allowed to carry the organs and pass them around). The teacher can also use the provided Unit III power point slide show to help students visualize the process of digestion.

   Nutrition permits us to take in and use food substances that the body converts to energy and body structure. The digestive system includes all the organs and glands involved in this process of eating and digesting. Starting in the mouth, a long muscular tube provides continual fluid and vital nutrients. The coiled intestines alone are about 24 feet long. After we consume food, the body mechanically and chemically breaks it down, then transports it for absorption and defecation (final waste removal). The digestive glands (salivary glands, pancreas, liver, and gallbladder) produce or store secretions that the body carries to the digestive tract in ducts and breaks down chemically.

   Ingestion
   Food processing begins with ingestion (eating). The teeth aid in mechanical digestion by masticating (chewing) food. Mastication permits easier deglutition (swallowing) and faster chemical breakdown in the digestive tract. During mastication, salivary glands secrete saliva to soften the food into a bolus (semi-solid lump). Saliva contains the salivary amylase enzyme, which digests carbohydrates (starches), and mucus (a thick liquid), which softens food into a bolus. Ingestion starts both chemical and mechanical digestion.

   When the food (bolus) enters the esophagus, peristalsis (wave-like contractions) of smooth muscle carries the bolus toward the stomach. Two layers of smooth

muscle, the outer longitudinal (lengthwise) and inner circular, contract rhythmically to squeeze food through the esophagus. Throughout the digestive tract, smooth muscle peristalsis aids in transporting food.

Digestion: stomach
In the stomach, food undergoes chemical and mechanical digestion. Here, peristaltic contractions (mechanical digestion) churn the bolus, which mixes with strong digestive juices that the stomach lining cells secrete (chemical digestion).

The stomach walls contain three layers of smooth muscle arranged in longitudinal, circular, and oblique (diagonal) rows. These muscles allow the stomach to squeeze and churn the food during mechanical digestion. Powerful hydrochloric acid in the stomach helps break down the bolus into a liquid called chyme. A thick mucus layer that lines the stomach walls prevents the stomach from digesting itself. When mucus is limited, an ulcer (erosion of tissue) may form. Food is digested in the stomach for several hours. During this time, a stomach enzyme called pepsin breaks down most of the protein in the food. Next, the chyme is slowly transported from the pylorus (end portion of the stomach) through a sphincter and into the small intestine where further digestion and nutrient absorption occurs.

Digestion and absorption: small intestine
The small intestine is about 20 feet (6 meters) long and has three parts: the duodenum, jejunum, and ileum. The duodenum is where most chemical digestion takes place. Here, bile from the gallbladder and enzymes from the pancreas and intestinal walls combine with the chyme to begin the final part of digestion.

Bile liquid is created in the liver and stored in the gallbladder. Bile emulsifies (breaks into small particles) lipids (fats), which aids in the mechanical digestion of fats. The pancreas and gland cells of the small intestine secrete digestive enzymes that chemically break down complex food molecules into simpler ones. When food passes through the duodenum, digestion is complete and is ready to pass through the intestines for absorption of nutrients.

3. The teacher will then show a short video clip to the class, which demonstrates the process of digestion (video, "Human Body Functions" can be obtained at the Central Washington University Library).
4. After the video clip, the teacher will review the organs involved in the digestive system and the process by which food gets digested. The video clip ends with the intestines, which allows for the teacher to expand on the importance of the intestines in the digestive system.

5. The teacher will ask students how long the digestive system from mouth to anus might be. The nine meter rope will be extended, with help from the students, to help visualize the length of the digestive system. The teacher will then coil it back up into a ball to demonstrate that if compressed tightly it can fit into our bodies.

6. After the teacher presents the organs involved in the process of digestion, utilizing the human demonstration model, the teacher will ask the following questions to help provide any clarification the students may need.

   What is the function of the stomach, where is it located on the human demonstration model? What is the function of the pancreas and where is it located?
7. As the teacher is summarizing the digestive system the teacher will be able to identify which areas need clarification. At the end of the summary, students should be able to explain the function of digestion, the process, the organs involved and where they are located.
8. Students will fill out the provided digestion diagram with the organs and the function, see figure 2 in Appendix C.

Review (Spanish) Lesson 1: (Estimated time 1 hour)

Procedure: Possible student questions to elicit class or group discussions. These questions can be given out as a questionnaire to each student.

1. Introduction: The teacher will develop a questionnaire containing the following possible questions so students can review the importance of how a society can function correctly with the participation of both the community and family.

   ¿Cuando discutimos previamente, qué puedes recordar que ayuda a mantener una sociedad buena? ¿Cómo puedes relacionar usted estos aspectos a los sistemas de un cuerpo? ¿Puede funcionar el cuerpo humano correctamente sin los sistemas que trabajan apropiadamente y por qué? ¿Puede funcionar una sociedad sin comunidades y familias? ¿Cómo cree usted que podemos crear una mejor sociedad? ¿Cuales son algunas ideas que usted puede hacer para ayudar mantener nuestros sistemas?
2. The teacher will then pass out the questionnaire to students and give them 15 minutes to complete it.
3. After students finish completing the questionnaire, the teacher will guide students into the following activities.

4. Students will create a "World Body Tour Brochure" in which they will need to explain each of the systems that were discussed. The brochure will need to be detailed and informative.

   A. *Su equipo de 4 o 5 en la Agencia de Duodenum Dynamics ha sido empleado como un consultor de viaje para diseñar una visita del lujo por los Sistemas Humanos del Cuerpo. Antes de poder reunir su honorario de la Agencia de Duodenum Dynamics, ustedes tienen que producir un folleto. El dueño de la agencia de viajes, Sr. Seymore Sphincter, les ha informado que para ganar el contrato ustedes deben destacar los lugares importantes, las actividades*

emocionantes, y las importaciones y las exportaciones de las áreas. Para consideraciones de seguro, usted también debe mencionar discretamente algún peligro posible o las precauciones especiales que quizás encuentren cuando visiten estos sistemas. Su visita del cuerpo debe incluir las visitas a las sistemas siguientes: El sistema muscular, sistema Respiratorio y el aparato digestivo.

5. Format of the brochure is as follows:

   B. *26" X 32" papel del gráfico doblado en 3 secciones (6 anterior y atrás).*
   C. *6 pedazos de la medición de la tabla de cartel 8" X 13" deben ser pegados a cada sección.*
   D. *Dos sistemas tendrán dos secciones, un sistema tendrá una sección, y el titulo será la sección restante.*
   E. *La característica clave deberá dar un sentido general de la organización y la función de cada uno de las tres sistemas. Usted puede utilizar los dibujos, las gráficas por ordenador, y las fotografías de órganos verdaderos, los retratos de revistas, los diarios, o los libros para ayudar en su anuncio de cada sistema. Cuando puede, escribe con la máquina todas partes escritas del folleto.*
   F. *Cada grupo presentará oralmente su folleto a la clase, y nosotros votaremos en cuál equipo obtiene el contratoStudents will also have a copy of the indicated rubric,* see figure 3 in Appendix C.

Assessment

Students are assessed through the learning log (or KWL charts)
T-List, see figure 4 in Appendix C (O'Malley & Pierce, 1996).

Transitional Activity

How do we keep our systems functioning correctly?

APPENDICES

Appendix A

Figure 1:

Organelle Models for Dynamic Cell Simulation (not drawn to scale)

Please note: Content on this page was redacted due to copyright concerns.

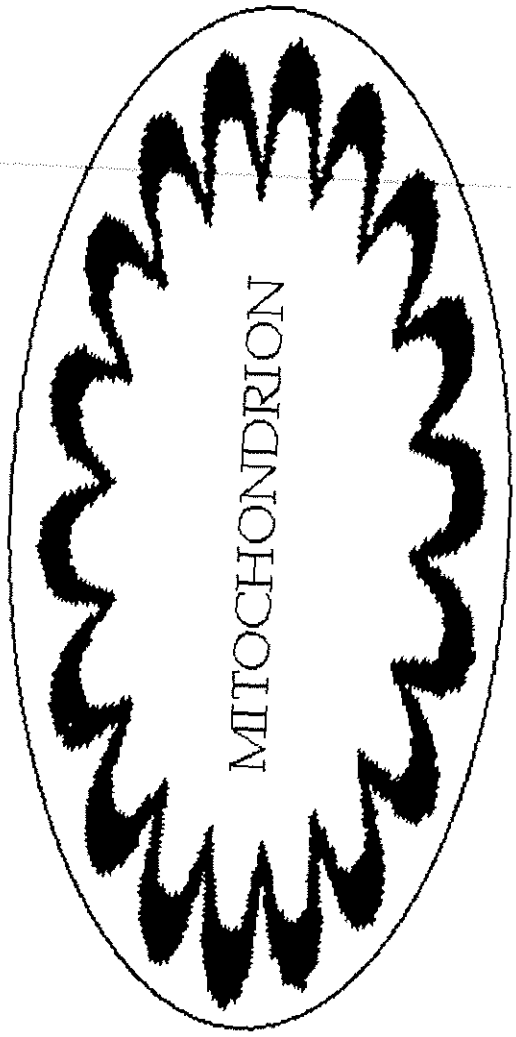
MITOCHONDRION

Figure 2:

The animal and plant cell are very much alike. Both have similar organelles, however, both are unique in that the plant cell possess additional organelles. Please compare and contrast which organelles are present in an animal cell vs. a plant cell using the following diagram.

Directions: Fill in the VENN Diagram to compare ***PLANT CELLS*** to ***ANIMAL CELLS***. Use the words in the word box.

cell membrane	cell wall	chloroplast	cytoplasm
mitochondria	nucleus	ribosome	vacuole

PLANT CELL ***ANIMAL CELL***

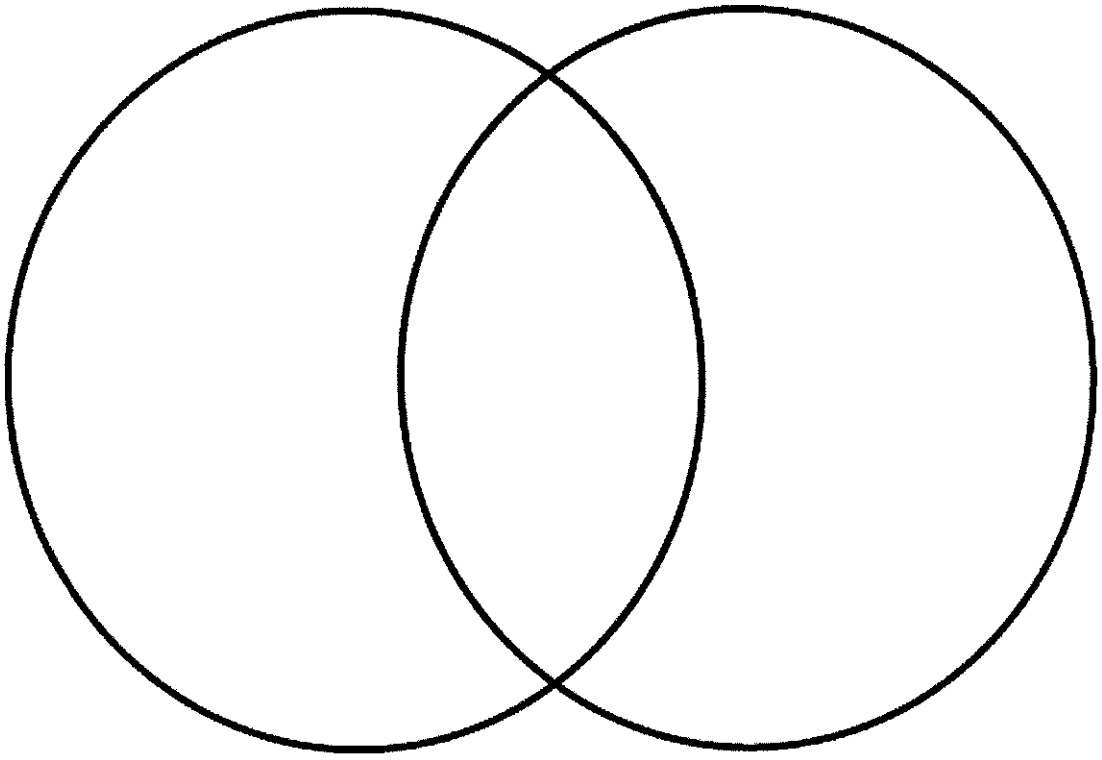

Figure 3:

DNA template and space for generating the corresponding mRNA molecule according to the rules that follow.

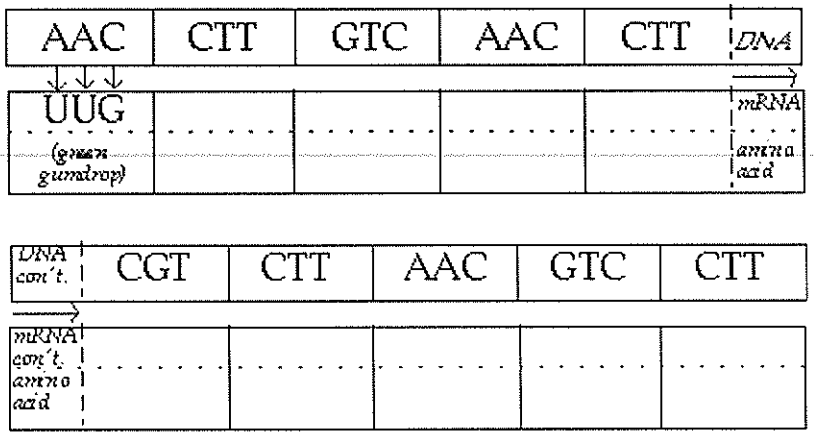

Figure 4:

Rules for converting DNA to RNA. The U stands for uracil, a nucleotide which is only found in RNA. RNA contains uracil in place of thymine, which occurs in DNA.

DNA		mRNA
T---	pairs with	--->A
A---	pairs with	--->U*
C---	pairs with	--->G
G---	pairs with	--->C

Appendix B

Figure 1:

Human Chromosome Spread and Karyotype

Please note: Content on this page was redacted due to copyright concerns.

Figure 2:

Teacher Observation Checklist (group sizes may vary)

Participation:	Student A	Student B	Student C	Student D
Contributed to discussion				
Used higher-level thinking skills				
Used text to support comments				
Elicited responses from others				
Listened to alternative points of view				
Inferred relationships not stated in text				

Appendix C

Figure 1:

Key:

1 = biceps brachii	2 = pectoralis major	3 = rectus abdominis	4 = sartorius
5 = latissimus dorsi	6 = trapezius	7 = gluteus maximus	8 = serratus anterior
9 = triceps	10 = gastrocnemius		

Figure 2:

Using the numbers from the diagram above, list, in order, the structures each mouthful of food or drink passes through on its way through the digestive process

#	Name	Description and Function
1	teeth	The strongest stuff in the body! Their purpose is to rip, grind, mash and generally pulverize all that food we put into our mouths. Why? So that it fits down our throats.
2	epiglottis	This trap door belongs to both the respiratory system and the digestive systems. Swallowing triggers its closing over the trachea to prevent food and fluids from draining into our lungs.
3	liver	One of the 'accessory' organs of digestion. Food doesn't actually pass through this organ. Instead, this organ secretes bile that is passed along to the gall bladder for concentration and storage.
4	gall bladder	Another accessory organ. Food doesn't touch this one, either. It is a pear-shaped sac about 4 inches long and is the reservoir, or storage tank, for bile. Concentrated bile is released into the duodenum as needed to break down fats into an absorbable form.
5	common bile duct	As close to a transport highway as we've visited so far. This duct collects donations from the liver and the gall bladder (bile) as it passes along to the duodenum of the small bowel.
6	large bowel	Is it poop yet? (We'll call it 'feces' [sounds like 'fee-cees'] or 'stool' from now on rather than 'poop' or other 's' words) Getting close. There are many sections to the large bowel – the appendix, caecum, ascending (rising) colon, transverse (across) colon, descending (going down) colon, sigmoid colon, the rectum and the anus. The main purposes of the large intestine is to pass remaining essential nutrients into the bloodstream and the storage and elimination of waste left-overs. As the nutritional fluids are absorbed and transferred out to the bloodstream, the contents get more solid and compact.
7	appendix	Little is understood about this little worm-like accessory structure that extends from the first section of the large bowel. Sometimes a piece of food gets stuck in here (like bubblegum) causing an infection.
8	salivary gland	3 main salivary glands deliver their juices, saliva, into the mouth. Have you ever noticed yourself drooling when someone's baking your favorite cookies? This fluid enzyme helps to soften up the food, the first chemical action along the digestive trail.
9	tongue	One very strong muscle made for rolling food around your mouth so your teeth can work best. It also houses taste buds; sensors of sweet, sour, salty and bitter tastes. If it doesn't taste good, are you going to swallow it? Probably not. The tongue can also act as a drawbridge – blocking the passage of food from entering further down the digestive tract and pushing it back out the mouth. (The tongue is also important for pronunciation, but how often do you eat your words?)
10	esophagus. (a.k.a. esophagus)	A muscular canal running from the pharynx to the stomach. The tongue pushes a 'bolus' of food into the esophagus to start it on its way to the stomach. Peristalsis is the name used to describe the rhythmic contract and release actions of this muscle and most all others along the digestive tract.
11	stomach	Most food that we eat becomes unrecognizable here in the stomach. Gastric acids are triggered by the presence of food that 'melt' the food into a thick soup.

12	duodenum	The duodenum is the first section of the twenty two foot long small intestine. It starts at the pyloric sphincter of the stomach and runs about 10 inches. The duodenum is largely responsible for the continuing food breaking-down process (fats are bombarded with bile), with the jejunum and ileum mainly responsible for the transfer of nutrients into the bloodstream.
13	pancreas	The body's sugar control board. If your blood sugar gets too high, insulin is released to counteract it. If your sugars are low, glucagon is released into the blood stream. Both insulin and glucagon are produced by the pancreas.
14	small intestine	The small bowel has 3 main sections: the duodenum, jejunum and ileum. The duodenum is responsible for continuing to break down of food into liquid form and the jejunum and ileum mainly responsible for absorption of nutrients into the bloodstream. The mostly digested contents continue to be transformed into feces as it is moved along by peristalsis – a rhythmic contraction and relaxation of the muscles of the intestines. Let the whole class do 'The Wave' to cheer on the digestive process.
15	rectum	The last portion of the large intestine used for storage of stool ready for disposal. When the rectum becomes full, it triggers nerves that carry that message to the brain. The reply says 'Time to look for a W.C.'

Figure 3:

Rubric for World Body Tour Brochure

FOUR POINT ASSESSMENT
1= the element described is missing
2= the element is present, but does not meet standard described
3= the element is present and meets standard, but needs some revision or improvement
4= the element is present and meets or exceeds the standard and no revision is recommended

Content 50%

1 2 3 4 Information presented is accurate, factual, and relevant to the specific topic
1 2 3 4 Research is in-depth and covers all systems and required topic areas
1 2 3 4 Time, energy, effort, enthusiasm, and group commitment to the project are evident
1 2 3 4 Project shows mastery of structure and function of human systems
1 2 3 4 Interrelationships between systems are clearly depicted and explained

Travel Brochure 30%

1 2 3 4 Travel brochure is neat and shows thought and effort
1 2 3 4 Travel brochure clearly illustrates all structures, functions, and risks associated with travel to each system
1 2 3 4 Travel brochure exhibits creativity

Oral presentation 10%

1 2 3 4 Presentation is smooth and shows evidence of preparation

Peer and Self Evaluation 10%

1 2 3 4 Evaluations show thought and effort
_____Total Points

Self And Peer Assessment

Please assess everyone in your group including yourself. This assessment should take into consideration cooperation and effort over the entire time allotted for completion of your project. Indicate the tasks performed by each group member and estimate the amount (%) of the total project which each member completed. Remember, the sum of the % should equal 100 %.

Group Members	Specific Project Tasks	% of Total Effort
1. Self		
2.		
3.		
4.		

5.		
		100% Total

Group Grade- Indicate the grade which you feel your group has earned. Briefly describe the reasoning for the group grade.
Group Grade _____ Remarks:

Respiratory System
OBJECTIVES:

1. Identify the structure and function of the parts of the respiratory system.
2. Explain the function of the ribs and diaphragm in the breathing process.
3. Describe what happens between the alveoli and the capillaries.
4. Describe the effects of smoking on respiration.
5. VOCABULARY TO BE INCLUDED IN THE PAMPHLET:
    a. alveoli, gas exchange, epiglottis, trachea, bronchi, bronchiole, larynx, lung, pharynx, respiration, trachea, inhalation, exhalation, cilia, respiratory control center, diaphragm (The teacher can modify the vocabulary that needs to be included).

The Digestive System
OBJECTIVES:

1. List the parts of the digestive system and give their functions.
2. Explain the results of the chemical digestion of carbohydrates, proteins and fats and discuss if this digestion occurs in the mouth, stomach and/or small intestines.
3. Discuss the importance of the liver and pancreas in digestion. List the substances they produce and explain their function.
4. Show the process of ingestion
5. VOCABULARY TO BE INCLUDED IN THE PAMPHLET:
    a. Digestion, salivary glands, epiglottis, esophagus, stomach, duodenum, liver, gall bladder, pancreas, small intestines, mesentery, villi, large intestines, mucous, peristalsis, amylase, hydrochloric acid, pepsin, bile (The teacher can modify the vocabulary that needs to be included).

Muscular System
OBJECTIVES:

1. Compare the structure and function of three types of muscles and give examples of where these muscles would be found in the body.
2. Explain the mechanism of muscle contractions.
3. Explain how muscles fatigue.
4. Show what a muscle fiber is made up of
5. Identify 10 major muscles of the body.
6. VOCABULARY TO INCLUDE IN YOUR PAMPHLET:

a. Belly, muscle fiber, myofibril, actin, myosin, skeletal muscle, smooth muscle, cardiac muscle, tendon, ligament, fatigue, acetylcholine (The teacher can modify the vocabulary that needs to be included).

Figure 4:

Sample T-List

Body System organs/tissue	Details
(EX.) Muscular System	
SMOOTH MUSCLE:	
SKELETAL MUSCLE:	
CARDIAC MUSCLE:	

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this project was to develop a culturally and linguistically responsive curriculum for secondary biology teachers. To accomplish this purpose, a review of literature was conducted. Additionally, selected materials were obtained and adapted for use.

Conclusions

Conclusions reached as a result of this project:

1. Students, who are committed to the bilingual program, will attain both basic communication skills but as well as the academic language, which will allow them to succeed in standardized test.
2. The mastering of a second language provides and increases the opportunity to communicate with a variety of people, it helps enhance academic achievement and language proficiency.
3. Students will be able to learn a second language while retaining and expanding their first language.
4. Students will be encouraged to enter science related courses or careers instead of shying away.

Recommendations

As a result of this project, the following recommendations have been suggested:

1. The enhancing of student knowledge, communication skills, academic achievement, language proficiency and the preservation of a students culture is essential.
2. To afford Hispanic high school students greater opportunities for experiencing success in science relate fields. Educational reformers should continue their advocacy for not only bilingual education, but for secondary bilingual education.
3. To develop and implement effective bilingual education programs, appropriate staff, materials, and support needs to be generated to have a positive effect on second language learners.
4. Other science bilingual educators seeking to apply a bilingual program at the secondary level, may wish to adapt the science bilingual curriculum developed, or undertake further research on this project to meet their unique needs.

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APPENDICES

Appendix D

Gomez, R. (n.d). An Overview of the Washington Language Proficiency Test (WLPT). Retrieved April, 2006, from Google search WLPT.

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