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Integrating technology into standards-based instruction for second grade English language learners

Catherine Levander Enbody

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INTEGRATING TECHNOLOGY INTO STANDARDS-BASED INSTRUCTION
FOR SECOND GRADE ENGLISH LANGUAGE LEARNERS

A Project
Presented to the
Faculty of
California State University,
San Bernardino

In Partial Fulfillment
of the Requirements for the Degree
Master of Arts
in
Education:
Instructional Technology

by
Catherine Levander Enbody

September 2002
INTEGRATING TECHNOLOGY INTO STANDARDS-BASED INSTRUCTION

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September 2002

Approved by:

Amy S.C. Leht¹, First Reader

John Ruttner, Second Reader

Date
ABSTRACT

Rapid growth in the use of technology in today's society coupled with the national focus on educational reform in recent years has resulted in the need for educators to integrate technology and standards-based instruction into their daily lessons. The growing number of students whose first language is not English requires a diverse set of teaching strategies and assessments to provide these students with optimal opportunities for achieving high standards.

A standards-based unit of instruction is designed for second grade students using the California Content Standards in Science, Language Arts, Writing, Math and technology standards from the International Society for Technology in Education. Incorporating the infusion of technology and a curricular design process ideally suited for standards-based instruction, the design allows for the use of the materials with students receiving content area instruction in English or in Spanish.

Project recommendations include a call for ongoing professional development and pre-service training programs to integrate standards-based instruction and curricular design with technology and strategies for a diverse population.
ACKNOWLEDGMENTS

The following people are gratefully acknowledged for their cooperation and assistance with this project:

Timothy Thelander, graduate assistant in the Graduate Studies Office of California State University, San Bernardino, for his continued encouragement and support and his invaluable help in formatting the project, and

Bonnie Butterfield, Coordinator of Information Resources/Webmaster at California State University at San Bernardino’s Palm Desert Campus, for her professionalism and consistent availability as a resource in finding research relevant to the topic.
DEDICATION

This work is gratefully dedicated to my husband, Steve, and his never-ending support and companionship. It is also dedicated to my Aunt Janet Carnes and my Great Aunt, Mrs. Doris Fisher - two master teachers who lead by example.
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CHAPTER ONE

BACKGROUND

Introduction

An overview of the project is presented in Chapter One. The project’s purpose is discussed followed by an explanation of the context of the problem and the significance of the project. Assumptions, or those things assumed with respect to the instructional setting, are delineated. Next, the limitations that apply to the project are reviewed. Finally, terminology particular to this area of study and, perhaps, unfamiliar to the reader are defined.

Purpose of the Project

The purpose of the project was to develop a unit of study on dinosaurs for second grade students, including those students who are receiving content instruction in Spanish, which would integrate second grade California Content Standards in Math, Writing, Language Arts and Life Science. The use of technology as a way to engage learners and help them show mastery of those standards and the inclusion of the use of rubrics as a means of assessment were also purposes of the study.
Context of the Problem

The context of the problem was to address the issue that California's teachers are being asked to teach to the standards while many of the textbooks adopted by school districts do not adequately address those standards. While addressing the content standards in their instruction, many teachers in California must address the needs of an ever-increasing number of second language learners. One of the options available for students whose primary language is not English is to receive content area instruction in their first language while their skills in English are being developed. Finding instructional materials that effectively address the content standards in a language other than English is often a difficult task, which requires teachers to develop their own materials or translate existing material.

Significance of the Project

The project was significant because when teachers can find ways to integrate the content standards from several areas (i.e. Math, Writing, Life Science) into one unit of study, instruction becomes more meaningful for the students. Integration of standards from more than one content area into a single lesson or group of lessons
allows teachers to teach more effectively in that students get more exposure to the standards they are required to master. Infusing these units of instruction with technology further engages the students in the learning process. By spending more time actively engaged in standards-based learning activities, student test scores on the norm-referenced California State test could increase.

The use of rubrics as a means of assessment provides students with a map of their learning and helps them to focus on the standards they are being asked to learn and the elements required for success. Rubrics can also serve as a reflective tool for students and teachers to plan future learning experiences.

Assumptions

The following assumptions were made regarding the project:

1. The instructional setting includes access to a variety of technology, including: at least one computer with internet access, some type of presentation software (mPower and PowerPoint are two well-known types), a digital video camera, video editing software (Imovie was used for this
project), graphing software (GraphClub is presented here), and sound editing software such as SmartSound. Additionally, in a classroom where there are only one or two computers, the use of AlphaSmarts keyboards was extremely helpful in allowing students time to type and edit their reports.

2. Students participating in this unit of study are being given content area instruction in either English or Spanish.

3. The instructional setting includes a varied selection of reading and reference materials at the appropriate reading level about dinosaurs, fossils and the Mesozoic Era.

4. The teacher implementing the instruction in this unit is familiar with the use of presentation software, digital cameras, digital video editing software such as Imovie or VideoBlender, sound editing software such as SmartSound and Sound Companion, Jr., and AlphaSmarts keyboards.

Limitations

The development of a standards-based unit of instruction on dinosaurs and fossils, which successfully
integrates technology and is designed for students receiving instruction in English or Spanish, presented some limitations.

The basic limitation of this project is that it does not include the use of the English Language Development Standards adopted by the State of California for students who are English Language Learners. Although the material’s presented are in English and Spanish, the unit is designed for students who are receiving primary language instruction in Spanish in the content areas (a waivered classroom under Proposition 227), or students whose first language is English and are receiving all instruction in English. While students in a waivered classroom receive English Language Development (ELD) instruction on a daily basis, the focus of this unit is not on ELD, but rather assumes that English Language Development would be instruction delivered at another time during the day.

Definition of Terms

The following terms are defined as they apply to the project.

**English Language Development** - Instruction designed to increase abilities to understand, speak, read and
write in English for students whose first language is not English.

**English Language Learners (ELLS)** - Students whose first language is other than English.

**Primary Language Instruction** - content area instruction given to students in their home language.

**Rubric** - a method of assessment in which students are made aware of what components they will be graded upon and the degree to which those components must be developed to merit a specific grade. The rubric is not only used for final assessment, but is shared with students at the beginning of the project so they can better target their efforts.

**Waivered Classroom** - Under California Proposition 227, a waivered classroom is one in which students' parents have signed a waiver requesting that their child receive content area instruction in their primary language while their skills in English are being developed. Such waivered classrooms provide English Language Development instruction on a daily basis.

**Organization of the Thesis**

The project's thesis portion consists of five chapters. The purpose of the project, context of the
problem, significance of the project, limitations and definitions of terms are contained in Chapter One. Chapter Two provides a review of literature relevant to the topic. Chapter Three documents the methodologies and materials used in developing the project. The project's design and the sequence for delivery are described in Chapter Four. Conclusions are presented in Chapter Five along with the recommendations drawn from the development of the project. The Appendices contain the lessons and materials for the project. Finally, the references.
CHAPTER TWO

REVIEW OF THE LITERATURE

Introduction

A discussion of the literature relevant to the topic is provided in Chapter Two. Specifically, the recent trends towards standards-based instruction and the integration of technology into curriculum are outlined. The implication of these trends in elementary education for English Language Learners is investigated. A look at some curriculum design methods and learning theories and their potential for use with standards-based instruction follows. Finally, the potential merits of the use of performance-based assessments and rubrics are discussed.

Standards-Based Instruction

Beginning with the 1993 report *A Nation at Risk* (National Commission on Excellence in Education) and what was termed "a rising tide of mediocrity" (as cited in Apthorp, Bodrova, Dean, & Florian, 2001, p. 9), much national attention has been given to improving the educational outcomes for America's diverse youth population. A decade of educational reform in the 1990's produced a federal law in 1996 that required states receiving federal Title 1 funds to develop standards for
instruction. This was followed in the year 2000 by the Goals 2000: Educate America Act, which offered a framework for states and communities to reach the National Education Goals (http://www.ed.gov/legislation/GOALS2000/TheAct).

In California, these mandates translated into the adoption as of 1999 of state-wide academic content standards in four core content areas: language arts, mathematics, history/social science and science (Martin-Kniep 2000). These content standards specify what students should know at each grade level and, by extension, what should be taught. In 1999, the California State Board of Education also adopted standards for English Language Development Standards for the Language Arts. These standards replace the language arts content standards for students whose first language is not English.

The primary goal of the standards movement has been to set high learning goals for students and help them achieve those goals. As a result of this nationwide attention to standards-based reform, standards are “beginning to serve as a foundation for designing new classroom curricula...in districts and states across the country” (Apthorp et al., 2001, p. 9).
While teachers are being asked to teach to the standards, difficulties arise when it becomes apparent that many of the textbooks used in public schools are not aligned to the standards. This proves especially difficult for teachers new to the field, that sometimes rely on the security of the page-by-page instructional sequence offered by those same textbooks. For other educators, standards represent yet another top-down mandate with which they must comply - a series of items to be checked off in the "completed" column, rather than the foundation for creating learning environments that set and help students meet high standards (Apthorp et al., 2001).

In order to recapture the original intent of the standards, that of setting high learning goals for all students and helping them reach those high standards, teachers must focus on the standards in their instruction, rather than concentrating on covering a certain number of pages in the textbook. In seeking additional resources for standards-based instruction, many teachers have turned to the World Wide Web and the Internet to supplement lessons from the textbook. But the use of the internet and World Wide Web as a teacher resource is only a small part of the emphasis of technology in the schools.
Infusion of Technology

Educational reform continues with the call for teachers to integrate technology into instruction. Recent years have seen many grant programs, both federal and state, designed not only to bring technology into the schools equitably, but also to educate teachers on how to integrate technology into their curriculum. Since 1995, The U.S. Department of Education has sponsored the Challenge Grants for Technology in Education to build electronic communities and stimulate local innovations in the use of new learning technologies. The California Technology Assistance Project (CTAP) is a program funded by a grant from the California Department of Education in 1998 whose goal is to assist with integrating technology into teaching and learning (http://lacoe.edu/ctap). CTAP in turn sponsors the Schools of California On-Line Resources for Education website (http://www.score.k12.ca.us). This website provides Internet Resources and lesson plans supporting the California Content Standards and promoting information literacy. Clearly, funding opportunities and widespread public support exist to help educators integrate technology.
Research studies show the under-utilization of technology tools by classroom teachers. As with standards-based reform, understanding how to use computers as tools for learning and how to infuse existing instruction with technology requires extensive professional development opportunities or pre-service training. Teachers who are comfortable and knowledgeable in the use of computers might model positive computer uses for their students (Chiero, 1997). By receiving such professional development or pre-service training, the notion that using technology in the classroom will take time away from instruction in the core content areas may be replaced with the belief that computers and the use of technology can enhance curriculum and support critical thinking and student learning.

The use of technology as a tool for communicating ideas and demonstrating knowledge has some specific implications for today's diverse community of student learners. Those students who are learning a second language and culture can find new ways of expressing themselves through use of such things as graphic organizers and multimedia.
Implications for English Language Learners

"Acquisition of language, whether first or second, is a...process that is developed through contextual, meaningful activities that focus on language" (Heath, 1996, p. 107).

How will the use of standards-based curricula and the infusion of technology advance or delay the acquisition of English language skills and academic success for English Language Learners (ELLs)? Looking at some of the underlying theories of language development and bilingual proficiency could offer some insight into this question.

Challenging academic material, delivered in a student's native language will have a positive effect on the development of proficiencies in a second language, according to the Common Underlying Proficiency (CUP) model of bilingual proficiency proposed by Cummins (1996). The CUP model explains that the cognitive academic language proficiency skills (CALP), the kind of language that one needs to succeed academically, are skills that transfer from one language to another. Learning how to write a paragraph, make an outline or sequence events in a story are skills that transfer from one language to another. For this reason, one of the strategies used by teachers of
Specially Designed Academic Instruction in English is to focus on study skills that can help students to organize new information and make connections. Standards-based instruction, in which students are not only presented the standards that they will be working towards but refer back to those standards periodically to reflect on their progress, would include emphasis on those study skills and organizing features that are so important to the Common Underlying Proficiencies of second language acquisition.

Another key element for successful acquisition of a second language is a low affective filter. Research indicates that the more modalities are involved in the learning process, the more potential for satisfying human needs in the affective domain. The use of technology would therefore become a very powerful tool in this area (Jamieson & Chapelle, 1987). Technology tools such as graphic organizers can aid second language learners in constructing and making sense of new knowledge.

Jamison and Chapelle (1987), also acknowledged that understanding learning strategies gives insight into second language learning as well as strategies of successful and unsuccessful learners. What teaching strategies align themselves with the use of technology and standards-based instruction? In a 1996 study, Heath
demonstrated that when technology is integrated with the cooperative learning process, tolerance for cultural and linguistic differences is fostered and a sense of self-esteem is nurtured.

Learning Theories

“Recent movements such as constructivism and the infusion of technology in the curriculum offer real promise for improving the achievement of all students in the core subject areas” (Lunenberg, 1998, p. 75).

Standards-based instruction calls for teachers to look critically at the curriculum and uncover the desired skills and knowledge to include in their lessons. Integrating technology into those standards-based lessons requires that teachers draw from a range of teaching strategies and learning theories that can best serve the needs of their students.

Three categories of teaching types outlined by Adler in The Paideia Proposal make a more manageable task of discussing teaching strategies (as cited in Wiggins & McTighe, 1998). Adler outlines the three categories as: 1) Acquisition of Organized Knowledge, requiring Didactic (or Direct) Instruction, 2) Development of Intellectual Skills, by means of coaching and supervised practice, and
3) Enlarged Understanding of Ideas and Values using active participation, problem-based or cooperative learning. This third category of teaching type is where constructivist learning would be encountered.

Papert, in discussing teaching methods, described the dominant method of teaching in schools as having been instructionism, an idea based on the assumption that students are passive receivers of information imparted by teachers and instructional media (as cited in Jonassen, 1996). A foundational principal of constructivism is that students actively construct knowledge as they try to make sense of the world around them, making connections with what they already know about the world. In a constructivist environment students are ultimately responsible for their own learning, with the teacher serving as facilitator and coach. Cooperative learning is a teaching strategy that allows children to collaborate with others and share the process of constructing knowledge. The constructivist experience is thus broadened by the students' ability to reflect off the thinking of the group (Lunenburg, 1998).

So what does a constructivist environment look like? In a 1994 article by Lunenberg, Martin and Brooks give five principals for constructive pedagogy:
1) Posing problems of emerging relevance to the students. Relevance doesn’t have to be pre-existing for the students. Not all students come to the classroom interested in learning. Relevance can emerge through teacher mediation.

2) Structuring learning around “big ideas”. Constructivist teachers organize information around conceptual clusters of problems and questions. Students are more engaged when problems and ideas are presented holistically. Many students are unable to build concepts and skills from part to wholes.

3) Seeking and valuing students’ points of view. Awareness of students’ points of view help teachers make school experiences both contextual and meaningful.

4) Adapting curriculum to address students’ suppositions. The teacher can help students build bridges from present understandings to new, deeper knowledge.

5) Assessing students’ learning in the context of teaching. Authentic assessment focuses on analytical thinking and performance, whereas
norm-referenced, standardized tests focus on low-level rote skills.

Certainly, good teaching consists of knowing when to use each of these three types of teaching. Learning the alphabet, keyboarding skills, or the rules to playing tetherball would suggest direct instruction. Refining one's skills or deepening understanding would involve guided practice, feedback and conferencing provided by the coaching method.

With a focus on uncovering the standards that are the targets for students achievement and infusing the instruction with the constructivist learning opportunities provided by technology and cooperative learning, teachers can better prepare their students not only for the state-mandated standardized tests but also to be critical thinkers and skilled questioners of knowledge.

Accomplishing all these tasks within the confines of the school day may seem a monumental goal. In order to realize this goal, teachers need to have a great capacity for organization. This capacity becomes a critical component of standards-based instruction (Apthorp et al., 2001) Herein lies the importance of good curricular design, allowing the educator to focus on the instructional needs of the students and the possibility of
evaluating, adjusting and reflecting upon that instruction.

Curricular Design Methods

Traditional approaches to curricular design placed an emphasis on covering the curriculum and consisted of three main components: 1) Select a Topic, 2) Design and present activities, and 3) Assessment (Laturnau, 2001). The major fault with this approach lies in that the skills and knowledge necessary for success on the test were often not explained to students and once a grade had been calculated it was time to start a new unit of study, with no opportunity for reflection or re-visiting.

These activity-based units were often chosen for their seasonality (apples in the fall) or because they were engaging for students (the rainforest) but contained very little focus on any standards or benchmarks (Laturnau, 2001).

Standards-based instruction, with its focus on specific learning objectives and targeted assessment, requires a very different kind of design. This design must focus on both the design of the curriculum and design of the assessment. According to O’Shea (2002), translating the expectations within the state frameworks into a
description of student performance is the most difficult component of the standards-based planning process.

The Backwards Design Model proposed by Wiggins and McTighe in their book *Understanding by Design*, (1998), provides a step-by-step procedure for designing standards-based curriculum and assessments. In this model the design process is broken into three steps: 1) Identifying Desired Results, 2) Determining Acceptable Evidence and 3) Planning Instructional Experiences.

The first task is to choose which standards will be addressed within the unit. From the beginning, the focus is on the standards. Once the standards have been identified, the focus moves to deciding what will constitute acceptable evidence of the student’s mastery of those standards. Only after this planning has occurred are the actual lessons, projects and/or activities that support these objectives designed.

The second phase of the Backwards Design process is of particular importance in that it provides teachers the opportunity to design effective assessments that more closely mirror the targeted understandings than some previous assessments that might have been used, like the test at the end of the Chapter in the textbook. Designing the assessments allows teachers the opportunity to guide
students through the learning process by making those assessments more meaningful.

Assessments

Many types of assessment exist and they serve different purposes. Quizzes and test items assess for factual information, usually have a single or best right answer, and are easily scored using an answer key. Academic prompts are open-ended questions that require critical thinking versus recall and the preparation of a response or product. They allow for more than one best answer, require analysis, synthesis or evaluation along with an explanation or defense. Academic prompts are scored based on criteria or performance standards, and a certain amount of teacher judgment. Performance tasks or projects are authentic complex challenges that mirror the issues and problems faced by adults. These assessments require a performance or product and can be short-term or long-term. Performance tasks have an audience and feature a setting that is real or simulated. The purpose of the product or project relates to the audience and students have the freedom to personalize the task. The task, criteria and standards are known in advance and guide the students' work (Wiggins & McTighe, 1998).
In continuing with the high expectations for all students called for in the Goals 2000: Educate America Act, teachers must make plans that allow students the opportunity to see what constitutes high quality work. Students need meaningful and powerful images of what is outstanding, achievable and desirable. In addition to exemplars, students must have different and multiple opportunities to attain those high standards that include ongoing feedback on their work (Martin-Kniep, 2000).

Rubrics are scales that define and differentiate levels of student performance on a task or process. The use of rubrics can help teachers to focus their instruction by making clear expectation for students. Additionally, rubrics allow other to understand teachers’ criteria for judging students’ work, validating the meaning of assigned grades.

Good teaching and assessment require that teachers use a variety of assessment types, but in order for students to acquire the enduring understandings referred to by Wiggins and McTighe, performance tasks and projects must be included in the assessments.

When appropriately constructed, performance assessments ensure real world applications of student learning, meaningfully connect instruction with the discipline’s big ideas and concepts, allow for a variety of student
differences, and present opportunities for improving communication between schools and parents concerning student achievement. (Laturnau, 2001. p. 6)

Summary

In order to stem the "rising tide of mediocrity" referred to in 1993, researchers, legislators, and educators have sought ways to reform education in America. This chapter has attempted to review the major themes of that reform. Standards-based instruction and its focus on high academic expectations for all students was reviewed. The importance of integrating technology into educational opportunities for all students and the methods by which teachers can infuse technology into their lessons were outlined. The use of technology and standards-based instruction offers some opportunities for English Language Learners to achieve academically, to communicate more effectively and to build self-esteem in the process.

Teachers can move towards accomplishing these goals through the use of varied teaching and assessment strategies and an effective curricular design model known as Backwards Design.

The next Chapter will focus on the methodology particular to the project.
CHAPTER THREE
CURRICULAR DESIGN

Introduction

Chapter Three documents the Backwards Design process. Specifically, an explanation of the steps involved in the Backwards Design process begins this section, followed by a comprehensive list of the resources used in designing the instruction particular to the project. The target audience is described. Methods used for content validation are presented along with the various teaching strategies used within the unit. Chapter Four takes the reader through the development of the dinosaur studies unit in detail using this process.

Backwards Design

While content standards tell us what to teach, the task of discovering how to teach it falls to teachers. The Backwards Design Process brings more focus and coherence to instruction. The process is divided into three steps, or stages, as illustrated in Table 1. These three phases of the design process are further explained in this section.
Table 1. The Big Picture of Backwards Design

<table>
<thead>
<tr>
<th>Key Design Question</th>
<th>Design Considerations</th>
<th>Filters (Design Criteria)</th>
<th>What the Final Design Accomplishes</th>
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<tr>
<td>Stage 3. What learning experiences and teaching strategies promote understanding, interest, and excellence?</td>
<td>Research-based repertoire of learning and teaching strategies. Essential and enabling knowledge and skill.</td>
<td>WHERE Where is it going? Hook the students. Explore and equip. Rethink and revise. Exhibit and evaluate.</td>
<td>Coherent learning experiences and teaching that will evoke and develop the desired understandings, promote interest, and make excellent performance more likely.</td>
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(Wiggins & McTighe, 1998, p. 18)

Stage One - Identify Desired Results

The content standards pertinent to the project are identified, clustered and prioritized. The question to be asked at this point is "What should students know, understand, be able to do?" The unit is then further
focused by using the criteria of uncovering the enduring understandings desired from the study. Essential unit questions are articulated here. These questions will guide students in their learning.

Stage Two – Determine Acceptable Evidence

Among the questions to be answered at this stage are:

1) What assessment evidence will be collected? 2) How will we know if students have mastered the standard? 3) What types of assessment are necessary?

The backwards approach pushes educators to plan what they will collect as evidence of understanding and to design those assessments prior to the lessons. Assessments should be of diverse types ranging from informal checks for understanding through observations, quizzes and tests, academic prompts and performance tasks or projects. The latter type focuses more towards the curricular priority of enduring understanding than do quizzes and tests.

Another consideration in determining what type of assessments to use is how those assessments demonstrate the six facets of understanding. This model for student learning, as outlined in Table 2, show six areas in which students can demonstrate understanding. They include explanation, interpretation, application, empathy,
self-knowledge and perspective. Unlike Bloom’s Taxonomy, the facets of understanding are not hierarchical.

Additionally, it is not essential to use all of the six categories in every unit of instruction, but rather preferable to target multiple facets within each instructional endeavor.

Table 2. The Six Facets of Understanding

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<tr>
<th>Explanation</th>
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<th>Application</th>
<th>Perspective</th>
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<td></td>
</tr>
<tr>
<td>Provide</td>
<td>Draft a Supreme</td>
<td>Make an</td>
<td>Research the</td>
<td>Develop a resume</td>
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<td>conceptual</td>
<td>Court decision on</td>
<td>audiocassette of</td>
<td>impact of</td>
<td>and a description</td>
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<td>clarification</td>
<td>a First Precedent</td>
<td>a favorite book</td>
<td>welfare-to-work</td>
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<td></td>
<td>case</td>
<td>for the school</td>
<td>laws on low-</td>
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<td>library</td>
<td>income people</td>
<td>strengths and</td>
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<td>weaknesses</td>
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</tbody>
</table>

27
<table>
<thead>
<tr>
<th>Explanation</th>
<th>Interpretation</th>
<th>Application</th>
<th>Perspective</th>
<th>Empathy</th>
<th>Self-Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reveal subtle and easily overlooked patterns in phenomena or data</td>
<td>Do a trend analysis of a finite data set</td>
<td>Design a museum exhibit on the causes and effects of early 20th century immigration</td>
<td>Write critical reviews of novels based on recent-discredited paper you write to scientific the paper as you writings to find turn it in what is of value in the analyses</td>
<td>Read and discuss Attatch a self-pre-read or assessment each</td>
<td></td>
</tr>
<tr>
<td>Clarify the reasons for fear and develop a statistical analysis of crime trends to predict police staff need in 2010</td>
<td>Conduct thought experiments</td>
<td>Conduct thought experiments</td>
<td>Reflect on why literature that confronts you with what is alien</td>
<td>Read and discuss Reflect on why students often say in class, &quot;I know this sounds stupid, but,&quot; before starting an interesting comment</td>
<td></td>
</tr>
<tr>
<td>Link everyday action and facts using primary sources and write a historical biography</td>
<td>Conduct research on local stream water to monitor national EPA compliance and present findings</td>
<td>Self-assess your writing as if you were an editor for a magazine</td>
<td>Write a report on why some kids to an ineffective cooperative on the basis of what didn't work in like to be those your group</td>
<td>Propose solutions</td>
<td></td>
</tr>
<tr>
<td>(Wiggins &amp; McTighe, 1999, p. 152)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Stage Three - Plan Learning Experiences and Instruction**

Having identified the desired results and assessments for the unit, in this stage the instructional activities, resources and teaching strategies can now be mapped out. Identifying the knowledge and skills that students will need for success is part of this stage. For example, it would be difficult for students to write a paragraph with a topic sentence and supporting detail sentences if there are some students in the room who cannot identify a complete sentence yet. Constructing a graph would require that students be able to count and sort objects using a
tally system. Likewise, the materials and resources that will best uncover the content must be assembled. When considering the use of various teaching strategies, it is important to realize that certain strategies are better suited for use with some types of activities than others. Application of the design criteria listed for this stage in Table 2 will help narrow the search for strategies appropriate to the instruction.

The Backwards Design Process allows teachers to use their time efficiently and effectively. The process of uncovering essential understandings and determining ways in which students can show evidence of their understanding prior to designing the activities and teaching strategies to be used to get there provides a means for teachers to better target their efforts for greater student learning.

Resources

The resources used in the development of this unit are described in this section. Those resources include the content and technology standards adopted or in use by the State of California, print material in the form of textbooks, trade and resource books and technology resources. In addition to the State of California grade level content standards for instruction, the Palm Springs
Unified School District has targeted a number of these standards at each grade level to be identified as Power Standards. The district chose the Power Standards as those California Standards deemed most vital for each grade level. In the list that follows, all California second grade level content standards that pertain to this unit have been provided. Those standards identified as Power Standards by the Palm Springs Unified School District have been followed with an asterisk.

**Standards**

**Life Science**

2.0 Plants and animals have predictable life cycles. As a basis for understanding this concept:

 c. Students know many characteristics of an organism are inherited from the parents. Some characteristics are caused or influenced by the environment. *

**Earth Science**

3.0 Earth is made up of materials that have distinct properties and provide resources for human activities.

As a basis for understanding this concept:

 d. Students know that fossils provide evidence about the plants and animals that lived long ago and that scientists learn about the past history of Earth by studying fossils. *
Investigation and Experimentation

4.0 Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations.

Students will:

c. Compare and sort common objects according to two or more physical attributes (e.g., color, shape, texture, size, weight).

e. Construct bar graphs to record data, using appropriately labeled axes. *

Language Arts Content Standards

Reading

1.0 Word Analysis, Fluency and Systematic Vocabulary Development - Students understand the basic features of reading. They select letter patterns and know how to translate them into spoken language by using phonics, syllabication, and work parts. They apply this knowledge to achieve fluent oral and silent reading.

Decoding and Word Recognition

1.6 Read aloud fluently and accurately and with appropriate intonation and expression. *

2.0 Reading Comprehension - Students read and understand grade-level appropriate material. They draw upon a variety of comprehension strategies as needed (e.g., generating and responding to essential questions, making predictions, comparing information from several sources).
Structural Features of Informational Materials

2.1 Use titles, tables of contents, and chapter headings to locate information in expository text. *

Comprehension and Analysis of Grade-Level-Appropriate Text

2.5 Restate facts and details in the text to clarify and organize ideas. *

2.7 Interpret information from diagrams, charts, and graphs. *

Writing

1.0 Writing Strategies - Students write clear and coherent sentences and paragraphs that develop a central idea. Their writing shows they consider the audience and purpose. Students progress through the stages of the writing process (e.g., prewriting, drafting, revising, editing successive versions).

Organization and Focus

1.1 Group related ideas and maintain a consistent focus. *

Penmanship

1.2 Create readable documents with legible handwriting. *

Research

1.3 Understand the purpose of various reference materials (e.g., dictionary, thesaurus, atlas). *

Evaluation and Revision

1.4 Revise original drafts to improve sequence and provide more descriptive detail. *
Written and Oral Language Conventions

1.0 Students write and speak with a command of standard conventions appropriate to this grade level.

Capitalization

1.6 Capitalize all proper nouns, words at the beginning of sentences and greetings, and titles and initials of people. *

Mathematics Content Standards

Statistics, Data Analysis, and Probability

1.0 Students collect numerical data and record, organize, display, and interpret the data on bar graphs and other representations:

1.1 Record numerical data in systematic ways, keeping track of what has been counted.

1.2 Represent the same data set in more than one way (e.g., bar graphs and charts with tallies). *

1.4 Ask and answer simple questions related to data representations. (California Department of Education website)

In addition to the content standards adopted by the California Department of Education, California teachers refer to the National Education Technology Standards for Students developed by the International Society for Technology in Education (ISTE). During this unit of study, students will:

• Use input devices (e.g., mouse, keyboard, remote control) and output devices (e.g., monitor, printer) to successfully operate
computers, VCRs, audiotapes, telephones, and other technologies.

- Work cooperatively and collaboratively with peers, family members, and others when using technology in the classroom.
- Create developmentally appropriate multimedia products with support from teachers, family members, or student partners.
- Use technology resources (e.g., puzzles, logical thinking programs, writing tools, digital cameras, drawing tools) for problem solving, communication and illustration of thoughts, ideas, and stories.


Textbooks and Print Resources

As indicated in Chapter One, there is an assumption that the instructional setting will contain a variety of trade books and resource materials pertaining to the subject area of dinosaurs and fossils. With regard to the textbooks, however, it is important to note the textbooks used when planning for this unit.

Science: Descubre las Maravillas/Discover the Wonder, ScottForesman (1993)

Language Arts: Abremundos/LiteratureWorks,

Silver Burdett Ginn (1997)

Math: Matemáticas/Mathematics,


The Step Up to Writing program (2nd ed, 2003) by M. E. Auman has recently been purchased for use at Two Bunch
Palms Elementary, and the direct instruction and modeling strategies included in that program were integrated into this project. Significant resources for this project were found in *Dinosaurs: the Latest Information and Hands-On Activities from the Museum of the Rockies* by Charlesworth and B. Sachatello-Sawyer from Scholastic Professional Books (1995).

The Desert Outreach program of the Palm Springs Desert Museum provides hands-on activities and demonstrations based on the science content standards to area school children. This program is included here as a resource. The actual content of these lessons and activities will be described in more detail in Chapter Four.

**Teaching Strategies**

In teaching for understanding, students must come to see that understanding means that they must figure things out, not simply wait for and write down teacher explanations. That effort requires teachers to alter not only the curriculum but also their teaching style. (Wiggins & McTighe, 1999, p. 32)

During the final stage of the Backwards Design process, the sequence of learning experiences and instructional strategies to be used was planned. This process involved identifying those ideas and skills that needed direct instruction and modeling, as well as
planning for those portions of the unit that could best be taught cooperatively with the teacher serving as coach or facilitator. These strategies and their use with specific portions of the unit will be further detailed in Chapter Four.

Content Validation

In order to insure the efficacy of the content and instruction planned for this project, the material was reviewed by and input sought from a variety of sources. For grade level content and developmental appropriateness, the 2nd grade instructional team at Two Bunch Palms Elementary was consulted. The Technology Advisory Committee, consisting of three elementary level teachers who are all graduate students in Instructional Technology, reviewed the unit contents focusing on the implementation of technology standards within the unit. Finally, the bilingual content presented was evaluated for its grammatical correctness and readability by two BCLAD certified elementary teachers, one a native speaker. The comments and suggestions provided by these three groups allowed for greater continuity and opportunities for students to demonstrate the six facets of enduring
understanding proposed by Wiggins and McTighe in Understanding by Design (1999).

Population Served

The lessons contained within this instructional unit were designed for second grade students in California who are receiving instruction in a Spanish primary language (waivered) classroom or in an English-only classroom. The dinosaur studies unit should ideally be implemented within the latter half of the school year, so students' abilities in reading, writing and "cooperative learning behaviors" have been developed sufficiently.

Summary

This Chapter has presented the components of the Backwards Design process to be used in developing the dinosaur studies unit, along with the resources drawn from in planning the lessons. The target audience was described and the process used for content validation was explained. The importance of the use of varied instructional strategies was introduced.

The following Chapter discusses how these processes, resources and strategies were implemented to design the instruction and assessment.
CHAPTER FOUR
IMPLEMENTATION

Introduction

Chapter Four takes the reader through the Backwards Design process specifically used in conjunction with the design of the dinosaur studies unit. Curricular priorities, enduring understandings and essential questions are identified in Stage One. In Stage Two, the acceptable evidence for competency is determined. The actual learning experiences are mapped out in Stage Three along with the instructional planning sequence. Further, a section is included to guide the teacher through the design and construction of the culminating project for the unit - a "living book" created using presentation software.

Backwards Design Process

Stage One - Identify Desired Results

As detailed in Chapter Three, the first stage of Backwards Design involves considering what students are to understand as a result of the study and to formulate the essential questions that will guide that study. A list of key knowledge and skills that students will acquire as a result of the unit is also necessary. Although Chapter
Three outlined many different standards that will play some part in the study, the enduring understandings for this unit were:

- Students will understand that fossils provide evidence of plant and animal life that lived long ago (Earth Science Standard 3.0d).
- Students will understand that by studying fossils, scientists can learn about plant and animal life from our past (Earth Science Standard 3.0d).
- Students will understand that a paragraph consists of a 'big idea' sentence and supportive detail sentences that expand upon that 'big idea' (Writing Standard 1.0).
- Students will understand that many characteristics of an organism are inherited from the parents and that some characteristics are caused or influenced by the environment (Life Science Standard 2.0c).
- Students will understand that common objects can be compared and sorted according to their physical attributes and that this data can be represented in a bar graph (Math Statistics, Data and Probability Standards c and e). (California Department of Education Website)

Although the other standards listed in Chapter Three are included in this unit to a greater or lesser extent, these five key understandings constitute the major goals of the instruction to follow. Having identified the enduring understandings, some essential questions to guide the study must now be formulated.
The essential unit questions should contain a number of ingredients. While the answers to these questions should directly support the desired understandings, they should also be framed in such a way as to engage learners and provoke interest in the study. These unit questions will be posted prominently in the classroom throughout the study, allowing students to refer back and reflect upon them as they work to discover their answers.

The essential questions for the dinosaur study were identified as:

- Why were Tyrannosaurus Rex' forelegs so short? (¿Por qué fueron las patas delanteras de Tyrannosaurus Rex tan cortas?)
- Why do 'longnecks' have long necks? (¿Por qué es que los cuellos largos tenían los cuellos tan largos?)
- How do scientists know where dinosaurs lived? (¿Cómo saben los científicos en donde vivieron los dinosaurios?)
- How does a bone turn into a fossil? (¿Cómo se convierte un hueso en fósil?)
- How could we make a picture with math, called a graph, to tell someone about dinosaurs? (¿Cómo...
podemos hacer una ilustración usando matemáticas, llamada una gráfica, para explicarle a otra persona acerca de los dinosaurios?

- How do good writers organize their ideas when they write? (¿Qué hacen los buenos autores para organizar sus ideas cuando escriben?)

These unit questions were formulated to uncover the enduring understandings that are the foundation for this unit, rather than to cover a specific chapter in a textbook. The template offered in Figure 1 offers an aid for teachers to use in arriving at these essential questions. The task now becomes to design the assessments that will determine to what extent students have attained these essential understandings.

**Stage Two - Determine Acceptable Evidence**

The considerations for design are to develop a continuum of assessments (ranging from informal checks through observations, quizzes and tests, through academic prompts, performance tasks and projects). To facilitate this development, the use of a template (see Figure 2) as a guideline will help teachers develop assessments that allow students to show the depth of their understanding through the six facets.
Given the targeted understandings or content standards for your unit, brainstorm possible overarching and topical essential questions to stimulate inquiry and guide the unit.

(Wiggins & McTighe, 1999, p. 121)

Figure 1. Identifying Essential Questions
Use the following prompts to generate ways that students can reveal their understanding of a topic within a course. The goal is to consider ways that understanding can be shown, not to use every prompt in every facet.

Understanding is demonstrated through explanation, interpretation, and application.

You *really* understand ______ when you can . . .

(unit or course topic)

<table>
<thead>
<tr>
<th>Explanation</th>
<th>Interpretation</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explain/teach ______</td>
<td>Interpret ______ ______</td>
<td>In a new situation. Apply ______ ______ ______ ______</td>
</tr>
<tr>
<td>Give examples of ______</td>
<td>Make sense ______ ______</td>
<td>Show or demonstrate ______ ______ ______</td>
</tr>
<tr>
<td>Make connections with</td>
<td>Tell a revealing story ______ ______</td>
<td>Use in the context of ______ ______ ______</td>
</tr>
<tr>
<td>Offer a sophisticated theory of ______ ______</td>
<td>Provide an apt analogy for ______ ______</td>
<td>Design/Invent ______ ______</td>
</tr>
<tr>
<td>Describe how ______</td>
<td>Justify/support ______ ______</td>
<td>Overcome a challenge or constraint, such as ______ ______</td>
</tr>
<tr>
<td>Provide/verify ______</td>
<td>Avoid common misconceptions, such as ______</td>
<td>______</td>
</tr>
</tbody>
</table>

(Wiggins & McTighe, 1999, p. 157)

Figure 2. Determining Acceptable Evidence

(Part A)
Use the following prompts to generate ways that students can reveal their understanding of a topic within a course. The goal is to consider ways that understanding can be shown, not to use every prompt in every facet.

Understanding is demonstrated through perspective, empathy, and self-knowledge.

You really understand ____________ when you can . . .

(UNIT OR COURSE TOPIC)

**Perspective**
- Analyze
- See from the point of view of
- Compare and contrast
- Critique
  - Critically examine assumptions such as
- Show how
- See the limits of

**Empathy**
- Walk in the shoes of
- Experience directly and see
- Reach a common understand with
  - concerning
- Entertain the seemingly odd or alien view that

**Self-knowledge**
- Recognize your prejudice
- Identify the lens through which you view
- See how your habits influence how you approach
- Explain how you came to understand
- Realize that even with all you now know, you don’t really understand

(Wiggins & McTighe, 1999, p. 159)

Figure 2. Determining Acceptable Evidence (Cont.)

(Part B)
Application. The student really understands how fossils are formed when they can demonstrate the process through creation of a storyboard for their clay animation video.

The student really understands graphs when, given a topic (e.g., carnivores vs. herbivores vs. omnivores) they can sort and count information and design a bar graph to show that information.

Explanation. The student really understands that species develop and adapt their physical characteristics to their environment when they can give examples of the physical characteristics of certain species and relate them back to the environment and survival needs of that species.

Interpretation. The student really understands how to read a graph when they can correctly interpret a graph produced by another student and explain the information it provides to someone else.

Self Knowledge. A student really understands their learning goals when they can identify areas that they still do not understand as well as those things they have learned through the study.

Perspective. A student really understands paragraph structure and organization when they can critique
another's paragraph and offer suggestions using the Step Up to Writing procedures (see Appendix A).

The understandings included here do not include the facet of empathy, as it did not lend itself to the unit of study. As previously indicated, the goal in this section is to consider ways that understanding can be shown, not to necessarily use every one of the six facets.

A rubric was designed for the culminating project of the dinosaur studies unit (see Table 3). In addition to the use of the rubric, student understanding will be assessed throughout the unit both formally and informally, through teacher observation, questioning for understanding and individual writing conferences.

Stage Three - Plan Learning Experiences

According to Wiggins and McTighe, in this stage there are two aspects to planning the learning experiences. Teachers must first consider what kinds of learning activities and conditions are those that engage students the most. The learning experiences must also be effective, that is, the activities, task directions, goals and work conditions must maximize student performance on the assessments. It is useful to list specific activities that fall into each category.
Table 3. Rubric for Cooperative Group Project

<table>
<thead>
<tr>
<th>Task</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photos taken</td>
<td>25-30 photos, all relate to topic, camera in same spot each time</td>
<td>18-25 photos, all relate to topic. May have some camera movement</td>
<td>12-18 photos relating to topic. Camera moved or fingers in pictures</td>
<td>Fewer than 12 pictures. Some pictures were unclear because of camera movement</td>
<td></td>
</tr>
<tr>
<td>Storyboard</td>
<td>Storyboard is neat and detailed, showing all steps to fossil formation</td>
<td>Storyboard shows major steps, but does not have many details or is not drawn neatly</td>
<td>Storyboard is missing information, making it difficult to understand</td>
<td>Storyboard does not explain how fossils are made, or is unreadable</td>
<td></td>
</tr>
<tr>
<td>Group tasks</td>
<td>Hooray! Each person in your group did their job and helped you make a great movie!</td>
<td>Alright! Most people did their jobs, with others helping out to get it all done</td>
<td>Your group had some difficulty with responsibilities, but the work got finished in the end</td>
<td>Some people in your group did not contribute - so some things did not get done</td>
<td></td>
</tr>
</tbody>
</table>
Engaging instructional activities involve:

1) Working in groups
2) Building something, using manipulatives
3) Using technology as a tool
4) End product has an audience

Effective instructional activities involve:

1) Performance rubric shared with students from the outset
2) Rewards/Incentives for group or individual achievements
3) Modeling is sufficient
4) Resources are at hand and on target
5) Scaffolding is provided
6) Opportunities to use acquired knowledge and skills in meaningful ways are present

Viewing the activities proposed for this unit through the design filters of engaging and effective instruction helped focus the design process.

Having brainstormed the components of engaging and effective instruction, a further aid in focusing the instructional planning is provided by the acronym WHERE (see Figure 3). By considering the answers to the questions evoked by this acronym, teachers can further
tailor the instructional design to maximize opportunities for student interest, engagement and performance.

<table>
<thead>
<tr>
<th>Questions for the Teacher</th>
<th>Responses from the Teacher</th>
</tr>
</thead>
<tbody>
<tr>
<td>How will you help students know they are headed and why (e.g., major assignments, performance tasks, and criteria by which the work will be judged)?</td>
<td>.</td>
</tr>
<tr>
<td>How will you hook students through engaging and through-provoking experiences (e.g., issues, oddities, problems, and challenges) that point toward big ideas, essential questions, and performance tasks?</td>
<td>.</td>
</tr>
<tr>
<td>What events, real or simulated, can students experience to make the ideas and issues real? What learning activities will help students to explore the big ideas and essential questions? What instruction is needed to equip students for the final performances?</td>
<td>.</td>
</tr>
<tr>
<td>How will you cause students to reflect and rethink to dig deeper into the core ideas? How will you guide students in rehearsing, revising, and refining their work based on feedback and self-assessment?</td>
<td>.</td>
</tr>
<tr>
<td>How will students exhibit their understanding about their final performances and products? How will you guide them in self-evaluation to identify the strengths and weaknesses in their work and set future goals?</td>
<td>.</td>
</tr>
</tbody>
</table>

(Wiggins & McTighe, 1999, p. 214)

Figure 3. Unit Design Considerations
The 'W' stands for where are we headed and why?

Students’ learning will be directed by the use of a concept/question board posted in the room at the beginning of the unit with the essential questions previously described posted. The assessment rubric will be distributed and discussed, as well as posted during the unit study. This will provide students with a map of where we are headed. Key items and deadlines in the rubric will be posted on the calendar.

The second letter in the acronym reminds designers that they must include a way to hook students through engaging and thought-provoking experiences. This can be accomplished in any one of several ways, depending on available time, resources and teacher creativeness. For this particular project, initiating the study with a visit from the Desert Museum’s Outreach Program is an activity that is designed to provoke thought and engage interest. A museum educator visits the classroom and brings several different fossil casts and bones of different sizes and shapes. Students act as scientists and try to ascertain which are fossils and which are not. They tabulate their answers on a clipboard as they circulate through the room examining the specimens. An explanation of fossils and their formation follows, followed by an opportunity for
students to make their own fossil cast out of plaster of
paris.

Exploring in-depth, equipping students with needed
skills for their final projects, and helping students to
explore the big ideas and essential questions are the
criteria evoked by the letter ‘e’. An in-depth study of
one particular dinosaur for their dinosaur report,
extensive modeling of the use of paragraph organizers and
daily graphing activities on a variety of topics are
provided to equip them with skills for their final
projects. Students will also revisit the essential
questions on the concept/question board regularly.

Opportunities for rethinking questions as well as
rehearsing, revising and refining their work must be
factored into the unit. Students will rehearse their
written reports and practice reading to a peer with
correct intonation, emotion and fluidity prior to
recording their voices into the sound editing software.

During the writing process and the creation of their group
storyboards, students will need to revise and refine their
work. Opportunities for rethinking the unit questions
could include working in groups to evaluate different
extinction theories and agree upon one theory that is most
plausible and their reasons for choosing that one. The
opportunity to rethink and revisit the concept/question board frequently during the study, together with ongoing questioning and probing by the teacher, could help uncover any misunderstandings that students have.

Opportunities to evaluate results come into play when students do a self-assessment using the rubric prior to the teacher’s assessment. They will also be provided with a self-knowledge prompt as part of their final assessment, describing what they feel are their areas of greatest strength and areas in which they are still unclear. During the writing process, students will peer review each others’ paragraphs on dinosaurs, offering suggestions using a template provided by the teacher. This will also provide the instructor with evidence of student understanding.

Although the exact sequence of instruction can be modified or arranged to suit the individual teacher’s calendar, it is important to give a general outline of some individual lessons to be included and the method of instruction to be used for those lessons. Materials and templates for student use have been provided in Appendices A and B.

Introduction - Concept/Question Board unveiled and discussed. Prior knowledge assessed. Presentation by
Desert Outreach program on fossils or other activity designed to engage student interest. Discussion of rubric components.

Ongoing - Whole and small group Reading instruction using literature selections dealing with dinosaurs and fossils taken from the literature series. Daily math activities involving graphs and graphing - ranging from direct instruction and modeling to guided practice sessions involving different kinds of graphing and other subject matter. Daily writing instruction from the Step Up to Writing program, modeling the paragraph structure in which whole and small groups use color-coded strips to identify parts of a paragraph and practice writing each kind of sentence included in the paragraph structure.

Specific Activities - At the beginning of the unit, each student will receive their own set of dinosaur sort cards (see Appendices A and B). These cards, much like baseball cards, contain a picture of a dinosaur species along with useful information about the dinosaur such as height, weight, diet, period in which they lived, etc. These cards, along with other activities included here, are included in Appendices A and B (English and Spanish) with permission from the publishers. Included in the
Appendices are several dinosaur activities that can be used with the project.

Culminating Project and Infusion of Technology

A multimedia presentation incorporating the students' dinosaur reports, graphs, and claymation movies is the culminating project for this unit. After the final, edited version of their paragraph has been completed, students will work in groups of three or four to type their paragraphs into an AlphaSmart keyboard. The use of the AlphaSmart keyboards is an accommodation provided because many primary grade classrooms are limited to one or two computers. As each student finishes their paragraph, they are guided through the process of connecting the keyboard to the computer and 'dumping' the information into a word-processing program. These files will be saved in a folder on the desktop labeled Reports.

Students can create original artwork depictions of the dinosaur they chose for their report. The students then take digital pictures of their artwork and transfer the files into a folder on the desktop that the teacher has created labeled Images. These pictures can be included in the multimedia presentation, providing a picture to go with their dinosaur report.
An activity that provides an opportunity for cooperative group work, measuring proportions and art is provided in the Appendices. Students are each given a small piece of a picture of a Velociraptor. They are asked to enlarge their small piece into an 8 1/2" x 11" puzzle piece. The pieces are then arranged to form a full-size Velociraptor. After the completed puzzle has been painted, a digital picture of their full-sized Velociraptor puzzle (see Appendix A) can be transferred to the images folder on the desktop as well, for use as a title page for the multimedia presentation.

After students have practiced reading their paragraphs to a partner and to the teacher, they can work with the teacher or an upper grade student to record their voices reading the text. Sound Companion, Jr. for KidPix is an excellent and easy-to-use sound editing program that can be used for this purpose. The resulting sound files can be saved as .wav files on the desktop in another folder titled Sounds.

The multimedia presentation can include a dinosaur sounds page in which students can record their idea of what a dinosaur sounded like. For this page, the teacher can use thumbnail images of the students' art work, or .gif images available on the World Wide Web. Some useful
websites for downloading free dinosaur images can be found in the Appendix E of the project. These images would also be stored in the Images folder on the desktop for later inclusion in the multimedia presentation.

After students have presented their group’s storyboard to the teacher, they can proceed to production of their clay animation sequence. Teachers unfamiliar with the clay animation process can find lots of useful templates and resources at http://napanet.net/~lotus72/claymation. Some of these templates can serve as scaffolding to guide the students through the cooperative group process and direct their work. The templates have been included in Appendices A and B.

Using non-drying oil-based clay, students will create a fossil. They can draw a background scene to use and design the different layers of earth as the fossil ages using the oil-based clay. The final version of their animations can take many forms. Some groups may elect to narrate the process and intersperse the narration with the animation sequences. Once the animation sequence has been filmed, using either a digital camera or digital video camera, the video can be edited by the teacher and
subsequently converted into a Quicktime Movie that can form part of the multimedia project.

During the course of the instructional unit students will have used the AlphaSmart keyboards, a digital camera and/or digital video camera and the sound editing software with the help of a teacher or cross-age tutor. Now the teacher can take this raw material and convert it into a multimedia project that can be used during a celebration with parents or other classes, burned onto a CD along with other artifacts of student learning that students can take home at the end of the year, or archived in the school library for other classes to view.

Summary

Chapter Four focused on the specific design of the project. The stages of the Backwards Design Process were followed to identify the enduring understandings desired for the unit and to construct the essential questions that guide the study. The six facets of understanding were used as a filter for determining acceptable evidence of having achieved the understandings. Lastly, the instruction itself was planned, and best teaching strategies were identified for the various lessons contained within the unit.
CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

Introduction

Chapter Five begins with a narrative of the conclusions derived from the completion of the project. Recommendations for ways to further this type of study, suggestions for school sites and districts, and ideas for teachers to consider as they begin to develop their own units of instruction using the Backwards Design process are outlined in the Recommendations section. The Chapter ends with a summary.

Conclusions

A national movement concerned with reforming American education exists. The effects of this national movement have resulted in the adoption of content standards and benchmarks of student achievement at both the state and local level. Educators are looking at ways to more accurately assess student growth and make teachers, schools and entire districts more accountable.

The rapid growth of the use of technology in today's society demands that educators incorporate it's use into their daily instruction so that students are better equipped to fully participate as citizens of our rapidly
emerging global community. Although the state of California has not yet adopted any specific technology standards for its students, many individual teachers and school districts have already begun using some type of learning continuum for their students.

The use of technology and, in particular, multimedia, as a tool for constructing and representing new knowledge has been shown to be a powerful way for all students, including those learning a new language and culture, to demonstrate that knowledge. Incorporating a variety of teaching strategies and performance assessments designed to promote interpersonal and critical thinking skills has been shown to have a great potential for increasing student's enduring understandings of subject matter. The use of rubrics as a shared tool or barometer, including posting important dates or deadlines on a classroom calendar, promotes study skills that have proven to be an important tool for second language learners. Rubrics also provide a valuable tool for demonstrating progress towards the mastery of standards and for sharing student information with other interested stakeholders, such as parents and community members.

Although great strides have been made in these areas, the full implementation of technology integration and
standards-based instruction and assessment is far from fully realized. The next section presents some recommendations suggested for the progress of these reforms in general and, more specifically, for individual teachers as they move towards incorporating these goals into their daily classroom instruction.

Recommendations

In the process of developing the project, several ideas presented themselves that may be of use to educators, administrators or policymakers.

When considering plans for ongoing professional development or pre-service teacher training, school districts and teacher preparation programs should consider ways to combine opportunities that demonstrate the effective use of standards-based instruction with ways to use technology as a tool for constructing and demonstrating knowledge. Just as teachers must find ways to effectively incorporate many elements into each instructional activity in order for students to have multiple opportunities for success, so district administrators and planners of professional development activities should integrate curricular design, standards-based instruction, technology integration and
performance-based assessments into their workshops and seminars to allow teachers more opportunities for success.

A recommendation for teachers interested in designing instructional units that incorporate the features outlined in this project is to start with a manageable plan. Appendix C provides persons interested in the Backwards Design Process with copies of the templates used in developing this instructional unit. Developing one such unit takes a considerable amount of time but, once designed and implemented, the unit can be used in subsequent years with any modifications taking far less time to implement. Working in collaboration with grade level teams in developing units of this type could prove very valuable, as teachers could pair up and design a unit together. They could then share out their work with other teachers in the district and in this way rapidly accumulate a collection of standards-based units relevant to all teachers at that grade level.

A recommendation for further development of projects of this type would be to design instruction that incorporates the use of the English Language Arts Standards for ELLs. The same type of collaboration outlined in the previous paragraph could be used with other teachers at a school site or within a district who
are looking for ways to incorporate those new standards and thus contribute to the high expectations held for all students.

Teachers planning to use this unit in their own classrooms must individualize it to best suit the needs of their own students. Items to consider would include ensuring the availability of textbooks and trade books pertinent to the study in advance of beginning the unit. Teachers should also keep in mind the skills and abilities that their students will need to succeed in their endeavors. Depending on the availability of resources, certain classroom management strategies may need to be utilized so that all students are able to complete their projects on a timely basis. Prior exposure to the interpersonal skills and behaviors needed to work successfully in cooperative groups should be ascertained.

A final recommendation concerns the development of multimedia projects, whether by students themselves in the later grades or by teachers in conjunction with students in the primary grades. Teachers are advised to investigate the individual software programs they intend to use and the compatibility of the files produced with these programs to their presentation software. For example: Are the sound files produced by the students in recording
their narrations capable of being imported into a Quicktime Movie? If students are writing their reports in Spanish, will the diacritical markings transfer across platforms from PC to MAC? Ascertaining the answers to these questions prior to beginning any production by the students will save much time and effort on the part of the teacher and, therefore, make the final product more valuable for subsequent use.

Summary

Standards-based instruction is here to stay. The rapid growth of technology and the challenges and opportunities that are represented therein for today’s learners must be addressed in K-12 education. The diverse nature of today’s student population requires teachers to address the needs of second language learners with specific teaching strategies, design methods and assessment opportunities.

This seemingly monumental task can be broken down and made more manageable for teachers by the use of the Backwards Design Method of curricular design. Professional development and pre-service programs need to integrate the combined use of these goals to assist today’s and
tomorrow’s teachers in helping every child to achieve to high standards.
APPENDIX A

LESSON MATERIALS - ENGLISH
Dinosaur Shapes

Reproduce this dinosaur to use with your KWL chart.
Activities for Use with Dinosaur Sort Cards

Dinosaur Identification Cards
The Dinosaur Identification Cards included in this Appendix can help students become familiar with 12 of the most popular species. Reproduce these pages. Then have students cut out the cards along the solid lines, fold the cards along the dashed lines, and paste them together. Invite students to use the cards with some or all of the activities below. If you like, encourage students to invent their own games or to create new cards focusing on other species that intrigue them.

A Question of Color (Reflective Thinking)
No dinosaur skin has ever been found, which means that no one knows for sure what color any of the dinosaurs were. Paleontologists do have a lot of theories, of course. Share and discuss these theories with students. Then challenge them to color their ID cards based on one of these theories or on a theory of their own. Encourage students to write a paragraph or two explaining their color choice and to share their expository writing with the rest of the class. What does the class think is the best theory? Take a poll!

Sorting Out Dinosaurs (Math)
This activity is designed to help students build sorting skills as they learn about specific dinosaurs. Using their identification cards, conduct group sorts, or have these sorting activities at a center. For example, sort the cards into two stacks: Dinosaurs whose bones have been found in the United States and Dinosaurs whose bones have not been found in the United States. Next, count the cards in each stack, record the number, and use the data to write a dinosaur fact sentence. (Most of these dinosaurs had bones found in the United States) Challenge students to think of new ways to sort their cards and to write about it. For example: Dinosaurs that weighed more than I do and Dinosaurs that weighed less than I do.
Sizing Up Dinosaurs (Math)
Create a bar graph to compare the lengths of the 12 dinosaurs on their ID cards. Have students find each dinosaur's length and record it on the graph by shading the appropriate number of boxes. Use different colors for each dinosaur, making the information easier to read. To give kids a concrete sense of the length of these dinosaurs, follow up this activity sheet with the "Life-Size Velociraptor Puzzle" activity included here.

Dueling Dinosaurs (Reflective Thinking)
This simple game is modeled on the classic card game War. Have each child choose a partner. Each partner shuffles his or her 12 ID cards and puts them in a stack, picture-side up. Next, players agree on one of these criterion for the round: weighs more, weighs less, is longer, is shorter, became extinct earlier, became extinct later. Let's say they choose weighs more. Now they both turn over their top dinosaur cards to reveal the dinosaurs' weights. The child with the card bearing the heavier dinosaur collects the other player's card. (If the dinosaurs weigh the same amount, each player keeps his or her own card.) After players have dueled with each of their 12 cards, they count their spoils. The player with the most cards wins. If students like, they can play another round with a different criterion. Cards are returned to their owners when the game is over.
**COELOPHYSIS**  
(see-lo-FISE-us)

**Name means:** hollow form  
**Bones found in:** United States  
**Lived during:** Triassic Period  
**Became extinct:** 202 million years ago  
**Ate:** meat  
**Walked on:** two legs  
**Measured:** 10 feet  
**Weighed:** 65 lbs.

**FAST FACTS:**
- *Coelophysis* was one of the very first dinosaurs.
- *Coelophysis* was a meat-eater whose diet may have included its own babies!
**BRACHIOSAURUS**
(BRAK-ee-uh-SAWR-us)

<table>
<thead>
<tr>
<th>Name means:</th>
<th>arm-lizard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bones found in:</td>
<td>Tanzania, United States</td>
</tr>
<tr>
<td>Lived during:</td>
<td>Jurassic Period</td>
</tr>
<tr>
<td>Became extinct:</td>
<td>145 million years ago</td>
</tr>
<tr>
<td>Ate:</td>
<td>plants</td>
</tr>
<tr>
<td>Walked on:</td>
<td>four legs</td>
</tr>
<tr>
<td>Measured:</td>
<td>75 feet</td>
</tr>
<tr>
<td>Weighed:</td>
<td>150,000 lbs.</td>
</tr>
</tbody>
</table>

**FAST FACTS:**

- *Brachiosaurus* was one of the biggest dinosaurs. He weighed as much as 15 elephants and stood as tall as a four-story building.
- *Brachiosaurus*’s nostrils were on top of its head.

The cards on these six pages will help you learn more about some of the dinosaurs. To make the cards, cut along the solid lines. Then fold along the dashed lines. Tape or paste the front and back of each card together.
**MAIASAURA**
*(my-uh-SAWR-a)*

**Name means:** good mother lizard  
**Bones found in:** United States  
**Lived during:** Cretaceous Period  
**Became extinct:** 73 million years ago  
**Ate:** plants  
**Walked on:** two legs  
**Measured:** 30 feet  
**Weighed:** 6,000 lbs.

**FAST FACTS:**
- Mother *Maiasaura* laid eggs and probably took care of their babies in the nest.
- Scientists think that *Maiasaura* lived in herds and migrated.
Iguanodon
(i-GUA-no-DON)

**Name means:** iguana tooth

**Bones found in:** Belgium, England, Germany, Mongolia, Tunisia, United States

**Lived during:** Cretaceous Period

**Became extinct:** 110 million years ago

**Ate:** plants  **Walked on:** two or four legs

**Measured:** 30 feet  **Weighed:** 10,000 lbs.

**FAST FACTS:**

► *Iguanodon* was one of the first dinosaurs to be discovered. In 1821, Mary Anne Mantell found its teeth while rock hunting.

► *Iguanodon* had a spike for a thumb, which was probably used to jab enemies.
**STEGOSAURUS**  
(STEG-uh-SAWR-us)

**Name means:** roof lizard  
**Bones found in:** United States  
**Lived during:** Jurassic Period  
**Became extinct:** 145 million years ago  
**Ate:** plants  
**Walked on:** two or four legs  
**Measured:** 30 feet  
**Weighed:** 4,000 lbs.

**FAST FACTS:**

- Stegosaurus's brain was only the size of a walnut.
- Stegosaurus's diamond-shaped plates may have been used to absorb sunlight to help keep him warm.

---

**Diagram of Stegosaurus**
PLATEOSAURUS
(PLAT-ee-oh-SAWR-us)

Name means: flat lizard
Bones found in: France, Germany, Switzerland
Lived during: Triassic Period
Became extinct: 210 million years ago
Ate: plants Walked on: two legs
Measured: 25 feet Weighed: 3,000 lbs.

FAST FACTS:
> Plateosaurus was one of the earliest dinosaurs.
> Plateosaurus's clawed fingers were probably used to rake up plants to eat.
**ViLOCI RAPTOR**
(vel-o-si-RAP-tor)

**Name means:** fast predator

**Bones found in:** Mongolia, China

**Lived during:** Cretaceous Period

**Became extinct:** 70 million years ago

**Ate:** meat

**Walked on:** two legs

**Measured:** 6 feet

**Weighed:** 150 lbs.

**FAST FACTS:**

- Fierce *Velociraptor* used its sharp teeth and clawed hands and feet to attack dinosaurs twice its size.

- A *Velociraptor* skeleton was found wrapped around a *Protoceratops* skeleton. Scientists think they died while fighting.
**TYRANNOSAURUS**
(tye-RAN-uh-SAWR-us)

**Name means:** tyrant lizard  
**Bones found in:** Canada, United States  
**Lived during:** Cretaceous Period  
**Became extinct:** 65 million years ago  
**Ate:** meat  
**Walked on:** two legs  
**Measured:** 45 feet  
**Weighed:** 14,000 lbs.

**FAST FACTS:**
- *Tyrannosaurus' arms were so tiny he couldn't even scratch his chin.*
- *Tyrannosaurus' 60 razor-sharp teeth were the size of steak-knives.*
**TROODON**
(true-OH-don)

**Name means:** wound-tooth

**Bones found in:** Canada, United States

**Lived during:** Cretaceous Period

**Became extinct:** 70 million years ago

**Ate:** meat

**Walked on:** two legs

**Measured:** 5 feet

**Weighed:** 50 lbs.

**FAST FACTS:**

- *Troodon* had a very large brain and may have been the smartest dinosaur.

- *Troodon* probably ate other species' eggs and babies.
**TRICERATOPS**
*(try-SAIR-uh-tops)*

**Name means:** three-horned face  
**Bones found in:** Canada, United States  
**Lived during:** Cretaceous Period  
**Became extinct:** 65 million years ago  
**Ate:** plants  
**Walked on:** four legs  
**Measured:** 30 feet  
**Weighed:** 16,000 lbs.

**FAST FACTS:**
- *Triceratops* had a beak like a turtle and sharp teeth that cut through leaves like a pair of scissors.
- *Triceratops* probably used its three sharp horns to attract female dinosaurs and defend itself.

---

**Dinosaur Identification Cards**
CORYTHOSAURUS
(ko-RITH-uh-SAWR-us)

**Name means:** helmet lizard

**Bones found in:** Canada

**Lived during:** Cretaceous Period

**Became extinct:** 72 million years ago

**Ate:** plants  
**Walked on:** four legs

**Measured:** 30 feet  
**Weighed:** 6,000 lbs.

**FAST FACTS:**

- Corythosaurus had a huge bump on its head, which looked like a dinner plate set on its edge. This is called a crest.

- Corythosaurus had pebbly skin that was the texture of a football.
COMPSOGNATHUS  
(komp-sug-NAY-thus)

Name means: pretty jaw. 
Bones found in: France, Germany. 
Lived during: Jurassic Period. 
Became extinct: 140 million years ago. 
Ate: meat. Walked on: two legs. 
Measured: 3 feet. Weighed: 6 lbs. 

FAST FACTS:

› Compsognathus was one of the smallest dinosaurs. It was about the size of a chicken. 
› Compsognathus feasted on tasty things like insects and lizards.
Life-Size Velociraptor Puzzle

Photocopy the Velociraptor puzzle page that follows. Cut the picture apart along the solid lines to make rectangular puzzles pieces. If your students like surprises, don't tell them what the image is!

Give a puzzle piece and a sheet of paper to each student. Make sure all 30 pieces are distributed. (If there are less than 30 children, give some students two puzzle pieces and two pieces of paper.)

Challenge each student to use a pencil to enlarge the puzzle piece’s image on the 81/2 x 11 inch paper. Stress that kids should be as accurate as possible. As students are working, circulate around the room to make sure they’ve all copied the image exactly. When everyone’s finished, have each student write the puzzle piece’s number on the back of their paper.

Now you are ready to assemble the puzzle. Clear a large floor space (at least 4-by-6 feet) and put the pieces together in numerical order. Go from left to right, laying six papers horizontally and five papers vertically, as illustrated above. If you didn’t tell kids what the image was, encourage them to predict what kind of dinosaur is emerging.

After the puzzle is complete, tape it together and invite kids to measure the dinosaur and compare its size with their own. Color, then hang the Velociraptor in the classroom to be enjoyed throughout your dinosaur unit or to be photographed as part of a multimedia presentation.
Explain to students that dinosaurs lived for an incredible 180 million years during the Mesozoic Era. The Mesozoic Era is divided into three periods: Triassic, Jurassic, and Cretaceous. Share information about these periods with kids, pointing out that different species lived during different periods. (For more information on the dinosaurs featured in this activity, see the Dinosaur Identification Cards on pages 57-62). Then illustrate this fact by inviting children to construct their own Mesozoic Era Time Lines. Here's how:

Provide students with photocopies of pages 22 and 23. Ask children to cut out their time lines along the solid lines and assemble them as shown, then cut out the dinosaurs. Next challenge students to read each clue (for example, "I'm eating a plant"), match it with the correct dinosaur (Plateosaurus), and paste it in place.

After kids have assembled their time lines, ask them to read the time lines by answering questions such as: Which is the earliest dinosaur shown? The latest? Which dinosaurs were alive during the Triassic period? Jurassic? Cretaceous? Which dinosaur lived 150 million years ago?

To Extend Learning

► Use the time line to reinforce math skills by posing questions such as: How many years long was the Triassic Period? Jurassic? Cretaceous? How many years earlier did Coelophysis live than Brachiosaurus?

► Add a strip of paper to the left-hand side of the time line to represent the Paleozoic Era (550 to 245 million years ago) and one to the right-hand side to represent the Cenozoic Era (65 million years ago to today). Challenge students to help you decide how long each strip should be. Then research the different creatures that lived during the Paleozoic Era (worms, jellyfish, and primitive reptiles, to name just a few) and what lived—and continues to live—during the Cenozoic Era (saber-toothed tigers and woolly mammoths—now extinct; cats, dogs, and us!).
**TRIASSIC PERIOD: 245-208 Million Years Ago**

- I'm chasing a lizard. 220 million years ago
- I'm eating a plant. 215 million years ago
- I've got tall plates on my back. 155 million years ago

**JURASSIC PERIOD: 208-135 Million Years Ago**

- I'm the smallest dinosaur here. 150 million years ago
- I'm the biggest dinosaur here. 148 million years ago
- I've got a spike for a thumb. 115 million years ago

**CRETACEOUS PERIOD: 135-65 Million Years Ago**

- I've got a big bump on my head, called a "crest." 80 million years ago
- I've got curled claws on my feet. 75 million years ago
- My nickname is T. rex. 66 million years ago
Cut out the time line along the solid lines so that you have three pieces. Paste the piece labeled "Jurassic Period" to the right-hand side of the "Triassic Period" piece. Then paste the "Cretaceous Period" piece to the right-hand side of the "Jurassic Period" piece. When you're done, it should look like this:

Next cut out the dinosaurs on this page. Use the clues to match the dinosaurs to the times they lived, and paste them in place.
<table>
<thead>
<tr>
<th>Dinosaur Printouts</th>
<th>Label the Dinosaurs</th>
<th>Dino Information Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ankylosaurus</strong> - an armored, spiked plant-eating dinosaur with a club-like tail.</td>
<td></td>
<td><strong>Parasaurolophus</strong> - a plant-eating dinosaur with a long crest on its head.</td>
</tr>
<tr>
<td><strong>Apatosaurus</strong> - a plant-eating dinosaur with a long neck and a whip-like tail.</td>
<td></td>
<td><strong>Spinosaurus</strong> - a huge, meat-eating dinosaur with a sail on its back.</td>
</tr>
<tr>
<td><strong>Compsognathus</strong> - a chicken-sized meat-eating dinosaur.</td>
<td></td>
<td><strong>Stegosaurus</strong> - a plant-eating dinosaur with plates on its back and spikes on its tail.</td>
</tr>
<tr>
<td><strong>Iguanodon</strong> - a plant-eating, duck-billed dinosaur with thumb spikes.</td>
<td></td>
<td><strong>Triceratops</strong> - a plant-eating dinosaur with 3 horns on its head.</td>
</tr>
<tr>
<td><strong>Pachycephalosaurus</strong> - a plant-eating dinosaur with a thick skull and bony knobs on its head.</td>
<td></td>
<td><strong>Tyrannosaurus rex</strong> - a huge, meat-eating dinosaur with tiny arms.</td>
</tr>
</tbody>
</table>

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Dinosaur Research
by ________________________

1. The name of my dinosaur is ____________________________

2. It's name means ____________________________

3. How long was this dinosaur? ____________________________

4. How much did this dinosaur weigh? ____________________________

5. What did this dinosaur eat? ____________________________

6. How did this dinosaur protect itself? ____________________________

7. Where have this dinosaur's bones been found? ____________________________

8. In what time period did this dinosaur live? ____________________________

9. When did this dinosaur become extinct? ____________________________

10. Did this dinosaur have any special characteristics? ____________________________

Other interesting facts about this dinosaur ____________________________
Cinematographer

Responsibilities:

1. Camera operation and filming
2. Keeps the camera clean and safe (no fingers on clay)
3. Takes all photographs
4. Returns camera equipment to teacher
Director/Producer

Responsibilities:

1. Makes sure the filming sticks to the storyboard
2. Monitors progress of shots
3. Keeps the disks in a safe place
4. Team cooperation coordinator
5. Organizes clean-up of filming area including cleaning of clay residue.
6. Makes sure that the clay movement (animation) demonstrates the science concept
Set Designer

Responsibilities:

1. Designs scene with input from group
2. Maintains scene continuity
3. Manages details concerning the set and clay objects
4. Prepares set materials (background, props, signs, etc.)
Choreographer

Responsibilities:

1. Makes a “planning guide” for clay movements
2. Rehearses movements of clay objects with paper cut-outs
3. Moves clay model during filming
4. Stores clay objects carefully after filming
Clay Animation Group Planning Sheet

Science concept being filmed: ____________________________________________

Science facts we need to demonstrate in our movie:
1. ______________________________________________
2. ______________________________________________
3. ______________________________________________
4. ______________________________________________
5. ______________________________________________

Cooperative group assignments:
• Cinematographer (responsible for the camera operation and filming) __________________________________
• Producer (responsible for making sure the filming sticks the storyboard) _____________________________
• Set Director (responsible for the scene design, scene continuity, and details) __________________________
• Choreographer (responsible for how the characters or clay creations move, how far each thing is moved between shots, and how the moving of the clay will demonstrate the science concept)

Checklist of Planning Requirements
1. All four members: Complete the storyboard
2. Cinematographer & Set Director: Completes the Camera Planning Guide page
3. Producer and Choreographer: Rehearse the movements from the storyboard using paper models. You must ensure that the movements are small, easily seen, and demonstrate the science concept.
Clay Animation Camera Planning

Sheet

Completed by __________, the Cinematographer and __________, the Set Director.

Science concept being filmed: ____________________________

1. Camera being used ____________________________
2. Disks or files used ____________________________
3. Number of photographs being taken: ____________________________
4. Color of background ____________________________
5. Location for filming (table, etc) ____________________________
6. Type of lighting being used ____________________________
7. Direction of shadows ____________________________
8. Draw a picture of the set area from a bird's eye view. Label the background, camera location, and clay animation object locations. Use a new sheet of paper for this drawing. Staple it to this planning sheet.
9. Draw a picture of the set area from camera's eye view. Label the background, clay animation object, and where choreographer will be standing. Use a new sheet of paper for this drawing. Staple it to this planning sheet.
10. Turn in your two drawings and this planning sheet to the teacher.
<p>| | | |</p>
<table>
<thead>
<tr>
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</table>
# Rubric for Cooperative Group Project

<table>
<thead>
<tr>
<th>Task</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photos taken</td>
<td>25-30 photos, all relate to topic, camera in same spot each time.</td>
<td>18-25 photos, all relate to topic. May have some camera movement.</td>
<td>12-18 photos relating to topic. Camera moved or fingers in pictures.</td>
<td>Fewer than 12 pictures. Some pictures were unclear because of camera movement.</td>
<td></td>
</tr>
<tr>
<td>Storyboard</td>
<td>Storyboard is neat and detailed, showing all steps to fossil formation.</td>
<td>Storyboard shows major steps, but does not have many details or is not drawn neatly.</td>
<td>Storyboard is missing information, making it difficult to understand.</td>
<td>Storyboard does not explain how fossils are made, or is unreadable.</td>
<td></td>
</tr>
<tr>
<td>Group tasks</td>
<td>Hooray! Each person in your group did their job and helped you make a great movie!</td>
<td>Alright! Most people did their jobs, with others helping out to get it all done.</td>
<td>Your group had some difficulty with responsibilities, but the work got finished in the end.</td>
<td>Some people in your group did not contribute - so some things did not get done.</td>
<td></td>
</tr>
<tr>
<td>Clay object and backgrounds</td>
<td>Super job! Labels are clear, fossil is easy to see and colors really make your pictures nice!</td>
<td>All objects were labeled, fossils are easily seen, good colors.</td>
<td>All objects are labeled, fossil is not easy to see, color choices make it hard to see.</td>
<td>Some labels are missing, colors and fossils are hard to identify.</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX B

LESSON MATERIALS - SPANISH
Name

Dinosaur Shapes

Reproduce this dinosaur to use with your KWL chart.
Activities for Use with Dinosaur Sort Cards

Dinosaur Identification Cards
The Dinosaur Identification Cards included in this Appendix can help students become familiar with 12 of the most popular species. Reproduce these pages. Then have students cut out the cards along the solid lines, fold the cards along the dashed lines, and paste them together. Invite students to use the cards with some or all of the activities below. If you like, encourage students to invent their own games or to create new cards focusing on other species that intrigue them.

A Question of Color (Reflective Thinking)
No dinosaur skin has ever been found, which means that no one knows for sure what color any of the dinosaurs were. Paleontologists do have a lot of theories, of course. Share and discuss these theories with students. Then challenge them to color their ID cards based on one of these theories or on a theory of their own.
Encourage students to write a paragraph or two explaining their color choice and to share their expository writing with the rest of the class. What does the class think is the best theory? Take a poll!

Sorting Out Dinosaurs (Math)
This activity is designed to help students build sorting skills as they learn about specific dinosaurs. Using their identification cards, conduct group sorts, or have these sorting activities at a center. For example, sort the cards into two stacks: Dinosaurs whose bones have been found in the United States and Dinosaurs whose bones have not been found in the United States. Next, count the cards in each stack, record the number, and use the data to write a dinosaur fact sentence. (Most of these dinosaurs had bones found in the United States)
Challenge students to think of new ways to sort their cards and to write about it. For example: Dinosaurs that weighed more than I do and Dinosaurs that weighed less than I do.
Sizing Up Dinosaurs (Math)
Create a bar graph to compare the lengths of the 12 dinosaurs on their ID cards. Have students find each dinosaur's length and record in on the graph by shading the appropriate number of boxes. Use different colors for each dinosaur, making the information easier to read. To give kids a concrete sense of the length of these dinosaurs, follow up this activity sheet with the "Life-Size Velociraptor Puzzle" activity included here.

Dueling Dinosaurs (Reflective Thinking)
This simple game is modeled on the classic card game War. Have each child choose a partner. Each partner shuffles his or her 12 ID cards and puts them in a stack, picture-side up. Next, players agree on one of these criterion for the round: weighs more, weighs less, is longer, is shorter, became extinct earlier, became extinct later. Let's say they choose weighs more. Now they both turn over their top dinosaur cards to reveal the dinosaurs' weights. The child with the card bearing the heavier dinosaur collects the other player's card. (If the dinosaurs weigh the same amount, each player keeps his or her own card.) After players have dueled with each of their 12 cards, they count their spoils. The player with the most cards wins. If students like, they can play another round with a different criterion. Cards are returned to their owners when the game is over.
COELOPHYSIS
(see-lo-FISE-us)

Su nombre significa: forma hueca
Encontraron los huesos en: Estados Unidos
Vivió durante: período triásico
Se hizo extinto: hace 202 millones de años
Comió: carne Camino en: dos patas
Midió: 10 pies Peso ba': 65 libras

DATOS INTERESANTES
- Coelophysis fue uno de los primeros dinosaurios.
- Coelophysis fue un carnívoro que puede haberse comido a sus propias crías.

• Coelophysis fue uno de los primeros dinosaurios.
BRACHIOSAURUS
(BRAK·ee·uh·SAWR·us).

Su nombre significa: lagartija del brazo.
Encontraron los huesos en: Tanzania, E.E.U.U.
Vivió durante: período jurásico.
Se hizo extinto: hace 145 millones de años.
Comió: plantas
Camino en: cuatro patas
Midió: 75 pies
Pesaba: 150,000 libras

DATOS INTERESANTES
El Brachiosaurus era uno de los dinosaurios más grandes. Pesó igual a quince elefantes y fue tan alto como un edificio de cuatro pisos.
Las narices del Brachiosaurus se encontraban encima de la cabeza.

The cards on these six pages will help you learn more about some of the dinosaurs. To make the cards, cut along the solid lines. Then fold along the dashed lines. Tape or paste the front and back of each card together.
Su nombre significa: Predador.
Encontraron los huesos en: Mongolia, China
Vivió durante: Período Cretáceo
Se hizo extinto: hace 70 millones de años
Comió: Carne
Caminó en: dos patas
Midió: 6 pies
Pesaba: 150 libras

**DATOS INTERESANTES**
- El Velociraptor feroz usaba sus dientes afilados y las garzas de sus patas para atacar a otros dinosaurios el doble de su tamaño.
- Encontraron el esqueleto de un Velociraptor enredado con el esqueleto de un Protoceratops. Los científicos creen que murieron mientras peleaban.
TYRANNOSAURUS
(tye-RAN-uh-SAWR-us)

Su nombre significa: Rey tirano
Encontraron los huesos en: Canadá, E.E.U.U
Vivió durante: Periodo Cretácico
Se hizo extinto: hace 65 millones de años
Comió: Carne
Caminó en: dos patas
Midió: 45 pies
Pesaba: 14,000 libras

DATOS INTERESANTES

Sus patas delanteras de Tyrannosaurus fueron tan chiquitas que ni pudo rascarse la barbilla.

Los 60 dientes afilados de Tyrannosaurus fueron del tamaño de cuchillos para cortar carne.
Su nombre significa: diente herida
Encontraron los huesos en: Canada, E.E.U.U.
Vivió durante: Periodo Cretáceo
Se hizo extinto: hace 70 millones de años
Comió: Carne  Caminó en: dos patas
Midió: 5 pies  Pesaba: 50 libras

**DATOS INTERESANTES**

- Troodon tenía un cerebro bastante grande y puede que fue el dinosaurio más inteligente.
- Es muy probable que Troodon comía los huevos y bebés de otras especies de dinosaurios.
TRICERATOPS
(try-SAIR-uh-tops)

Su nombre significa: cara de tres cuernos.
Encontraron los huesos en: Canadá, E.E.U.U.
Vivió durante: Período Cretáceo
Se hizo extinto: hace 65 millones de años
Comió: plantas Caminó en: cuatro patas
Medió: 30 pies Pesaba: 16,000 libras

DATOS INTERESANTES

Triceratops tenía un pico como una tortuga y
dientes afilados que cortaban hojas como un par de
tijeras.

Es muy probable que Triceratops usaba sus tres
cuernos filosos para defenderse y para llamar la
atención a las dinosaurias.
El dinosaurio Maiasaura fue descubierto en el periodo cretácico, hace 73 millones de años. Se encontraron los huesos no solo en Canadá, sino también en Alemania y Bélgica. La madre Maiasaura pesaba alrededor de 6,000 libras y medía 30 pies de largo. Probablemente cuidaba a sus polluelos en el nido. Los científicos creen que los Maiasaúra vivieron en tandas y migraban.

DATOS INTERESANTES
- Nombre científico: Dinosaurio de diente de iguana
- Nombre común: Maiasaura
- Longitud: 30 pies
- Peso: 6,000 libras
- Comida: Plantas
- Combate: A menudo enlazando los huesos de dos Maiasauras y matando.

Encontraron los huesos en Belgrano, Argentina, en un nido de dos polluelos. Los científicos creen que los Maiasaúra eran mamíferos.

DATOS INTERESANTES
- Nombre científico: Iguanodon
- Nombre común: Iguana dorada
- Longitud: 30 pies
- Peso: 10,000 libras
- Comida: Plantas
- Combate: A menudo en grupo, lastimando a sus enemigos.
DATOS INTERESANTES

Corinthosaurus

Wimig: 30 pies, pesaba: 6,000 libras
Compsognathus: carne en cuatro patas
Se hizo extinto: 72 millones de años
Vico duró: período Cretácico
Encontraron los huesos en: Canadá
Su nombre significa: lagartija de casco

Corpsognathus

Wimig: 3 pies, pesaba: 6,000 libras
Compsognathus: carne en dos patas
Se hizo extinto: 145 millones de años
Vico duró: período Jurásico
Encontraron los huesos en: Francia, Alemania
Su nombre significa: mandíbula bonita

Corpsognathus

Wimig: 3 pies, pesaba: 6,000 libras
Compsognathus: carne en dos patas
Se hizo extinto: 145 millones de años
Vico duró: período Jurásico
Encontraron los huesos en: Francia, Alemania
Su nombre significa: mandíbula bonita

Corpsognathus

Wimig: 3 pies, pesaba: 6,000 libras
Compsognathus: carne en dos patas
Se hizo extinto: 145 millones de años
Vico duró: período Jurásico
Encontraron los huesos en: Francia, Alemania
Su nombre significa: mandíbula bonita
STEGOSAURUS
(STEG-uh-SAWR-us)

Su nombre significa: lagartija del techo
Encontraron los huesos en: Estados Unidos.
Vivió durante: período jurásico
Se hizo extinto: hace 145 millones de años
Comió: plantas Caminó en: dos ó cuatro patas
Medió: 30 pies    Pesaba: 4,000 libras

DATOS INTERESANTES
- Su cerebro de Stegosaurus era solamente del tamaño de una pelota de golf.
- Las placas de Stegosaurus tenían forma de diamante y puede que las usaba para absorber el sol y mantenerle cálido.
PLATEOSAURUS
(PLAT-e-oh-SAWR-us)

Su nombre significa: lagartija plano
Encontraron los huesos en: Francia, Alemania
Vivió durante: período triásico
Se hizo extinto: hace 210 millones de años
Comió: plantas Caminó en: dos patas
Midió: 25 pies Pesaba: 3,000 libras

DATOS INTERESANTES
Plateosaurus fue uno de los primeros dinosaurios.
Plateosaurus garras filosas a lo mayor fueron usados para escarbar plantas para comer.
Life-Size Velociraptor Puzzle

Photocopy the Velociraptor puzzle page that follows. Cut the picture apart along the solid lines to make rectangular puzzles pieces. If your students like surprises, don’t tell them what the image is!

Give a puzzle piece and a sheet of paper to each student. Make sure all 30 pieces are distributed. (If there are less than 30 children, give some students two puzzle pieces and two pieces of paper.)

Challenge each student to use a pencil to enlarge the puzzle piece’s image on the 81/2 x 11 inch paper. Stress that kids should be as accurate as possible. As students are working, circulate around the room to make sure they’ve all copied the image exactly. When everyone’s finished, have each student write the puzzle piece’s number on the back of their paper.

Now you are ready to assemble the puzzle. Clear a large floor space (at least 4-by-6 feet) and put the pieces together in numerical order. Go from left to right, laying six papers horizontally and five papers vertically, as illustrated above. If you didn’t tell kids what the image was, encourage them to predict what kind of dinosaur is emerging.

After the puzzle is complete, tape it together and invite kids to measure the dinosaur and compare its size with their own. Color, then hang the Velociraptor in the classroom to be enjoyed throughout your dinosaur unit or to be photographed as part of a multimedia presentation.
Explain to students that dinosaurs lived for an incredible 180 million years during the Mesozoic Era. The Mesozoic Era is divided into three periods: Triassic, Jurassic, and Cretaceous. Share information about these periods with kids, pointing out that different species lived during different periods. (For more information on the dinosaurs featured in this activity, see the Dinosaur Identification Cards on pages 57–62). Then illustrate this fact by inviting children to construct their own Mesozoic Era Time Lines. Here's how:

Provide students with photocopies of pages 22 and 23. Ask children to cut out their time lines along the solid lines and assemble them as shown, then cut out the dinosaurs. Next challenge students to read each clue (for example, "I'm eating a plant"), match it with the correct dinosaur (Plateosaurus), and paste it in place.

After kids have assembled their time lines, ask them to read the time lines by answering questions such as: Which is the earliest dinosaur shown? The latest? Which dinosaurs were alive during the Triassic period? Jurassic? Cretaceous? Which dinosaur lived 150 million years ago?

To Extend Learning
► Use the time line to reinforce math skills by posing questions such as: How many years long was the Triassic Period? Jurassic? Cretaceous? How many years earlier did Coelophysis live than Brachiosaurus?
► Add a strip of paper to the left-hand side of the time line to represent the Paleozoic Era (550 to 245 million years ago) and one to the right-hand side to represent the Cenozoic Era (65 million years ago to today). Challenge students to help you decide how long each strip should be. Then research the different creatures that lived during the Paleozoic Era (worms, jellyfish, and primitive reptiles, to name just a few) and what lived—and continues to live—during the Cenozoic Era (saber-toothed tigers and woolly mammoths—now extinct; cats, dogs, and us!).
**TRIASSIC PERIOD: 245-208 Million Years Ago**

- Estoy cazando un lagarto.  
  Hace 220 millones de años.
- Estoy comiendo una planta.  
  Hace 215 millones de años.
- Tengo planchas duras lo largo de mi espalda.  
  Hace 155 millones de años.

**JURASSIC PERIOD: 208-135 Million Years Ago**

- Soy el dinosaurio más pequeño aquí.  
  Hace 150 millones de años.
- Soy el dinosaurio más grande aquí.  
  Hace 148 millones de años.
- En vez de tener un pulgar, tengo una escarpia.  
  Hace 115 millones de años.

**CRETACEOUS PERIOD: 135-65 Million Years Ago**

- Tengo una protuberancia grande en mi cabeza.  
  Hace 80 millones de años.
- Las garras de mis patas están curvadas.  
  Hace 75 millones de años.
- Mi sobrenombre es T-Rex.  
  Hace 66 millones de años.
Mesozoic Era Timeline

Cut out the time line along the solid lines so that you have three pieces. Paste the piece labeled "Jurassic Period" to the right-hand side of the "Triassic Period" piece. Then paste the "Cretaceous Period" piece to the right-hand side of the Jurassic Period" piece. When you're done, it should look like this:

Next cut out the dinosaurs on this page. Use the clues to match the dinosaurs to the times they lived, and paste them in place.
Ankylosaurus - un dinosaurio blindado y pinchado que era herbívoro y que tenía una cola como una porra.
Apatosaurus - un dinosaurio herbívoro con un cuello largo y una cola como un látigo.
Compsoognathus - Un dinosaurio carnívoro que era del tamaño de una gallina.
Guanadon - un dinosaurio herbívoro que tenía el pico de un pato con pinchos en vez de pulgares.
Pachycephalosaurus - un dinosaurio herbívoro con un cráneo grueso y protuberancias huesudas en la cabeza.
Parasaurolophus - un dinosaurio herbívoro con una cresta larga en su cabeza.
Spinosaurus - un dinosaurio gigantesco y carnívoro que tenía una vela en su espalda.
Stegosaurus - un dinosaurio herbívoro con placas en su espalda y pinchos en su cola.
Triceratops - un dinosaurio herbívoro con tres cuernos en su cabeza.
Tyrannosaurus rex - un dinosaurio carnívoro y gigantesco que tenía sus patas delanteras muy chiquitas.
**Hoja de Información sobre dinosaurios**

**Nombre:** ____________________

**Contesta las preguntas en los espacios al lado.**

<table>
<thead>
<tr>
<th>Pregunta</th>
<th>Respuesta</th>
</tr>
</thead>
<tbody>
<tr>
<td>¿Cómo se llama tu dinosaurio?</td>
<td></td>
</tr>
<tr>
<td>¿Qué quiere decir su nombre?</td>
<td></td>
</tr>
<tr>
<td>¿Cuánto midió tu dinosaurio?</td>
<td></td>
</tr>
<tr>
<td>¿Comía plantas, carne o plantas y carne?</td>
<td></td>
</tr>
<tr>
<td>¿Cómo eran sus dientes?</td>
<td></td>
</tr>
<tr>
<td>¿En cuál período vivió?</td>
<td></td>
</tr>
<tr>
<td>¿Cómo caminaba tu dinosaurio?</td>
<td></td>
</tr>
<tr>
<td>Escribe uno de los datos interesantes de tu dinosaurio.</td>
<td></td>
</tr>
</tbody>
</table>
Cinematógrafo

Responsabilidades:

1. Operación de la cámara y filmando
2. Mantiene la cámara limpia y segura (no toca la plastilina)
3. Toma todos los fotos
4. Entrega la cámara y el equipo a la maestra.
Director/Produccionista

Responsabilidades:

1. Asegura que la filmación sigue los pasos del storyboard.

2. Observa el progreso de la filmación

3. Guarda los discos en un lugar seguro

4. Coordina la cooperación del grupo

5. Organiza la limpieza del escenario después de filmar, incluyendo cualquier evidencia de plastilina

6. Asegura que los movimientos de la plastilina (animación) demuestra el concepto científico
Director del Escenario

Responsabilidades:

1. Diseña el escenario usando las ideas del grupo
2. Mantiene la calidad del escenario
3. Maneja los detalles del escenario y los objetos de plastilina
4. Prepara materiales del escenario (escenario, avisos, cosas extras, etc.)
Coreógrafo

Responsabilidades:

1. Hace un plan escrito para los movimientos

2. Practica los movimientos de los objetos usando modelos de papel

3. Mueve la plastilina durante filmación

4. Guarda los objetos de plastilina con cuidado después de la filmación
Planificación del grupo

Concepto de ciencias que se va a filmar: ____________________________

Datos de ciencia que necesitamos demostrar en nuestra película:
1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________

Trabajos cooperativos:
• Videógrafo (responsable para la operación de la cámara y filmando) ______________________________
• Produccionista (responsable para asegurando que la filmación sigue los pasos del storyboard) ______________________________
• Director del escenario (responsable para el diseño del escenario, y detalles del diseño) ______________________________
• Coreógrafo (responsable para los movimientos de los personajes ó figuras de plastilina, que tanto se mueven entre fotos, y como el movimiento muestre el concepto de ciencia que quieren demostrar) ______________________________

Requisitos de planificación - lista de chequeo
1. Los cuatro miembros: Completan el storyboard
2. Cinematógrafo y Director del Escenario: Completan la Hoja de Planificación
3. Produccionista y Coreógrafo: Practican los movimientos que se indicaron en el storyboard usando modelos de papel. Hay que estar seguros que los movimientos están chiquitos, fáciles de mirar y que demuestren el concepto de ciencias.
Hoja de planificación para animación de plastilina

Hizo por _______________, el videográfico y _______________, el director del escenario.

Concepto de ciencias que se va a filmar: ______________________________________

1. Camera que usaron ________________________________________________
2. Discos o archivos que usaron ______________________________________
3. Número de fotos que van a tomar: _________________________________
4. Color del fondo del escenario ______________________________________
5. Lugar donde se filmó: _____________________________________________
6. Tipo de luz que usaron: __________________________________________
7. ¿Dónde aparecen las sombras? ______________________________________
8. Haz un dibujo del escenario mirándolo desde arriba. Indican el fondo del escenario, la posición de la cámara, y donde se van a ver los objetos de plastilina. Usa una hoja nueva para este dibujo. Engrápalo a esta hoja cuando lo termina.
9. Haz un dibujo del escenario mirándolo desde la cámara. Indican el fondo del escenario, la posición de la cámara, y donde se van a ver los objetos de plastilina. Usa una hoja nueva para este dibujo. Engrápalo a esta hoja cuando la termina.
10. Entregan los dos dibujos junto con esta hoja a la maestra.
Storyboard
## Rubric for Cooperative Group Project

<table>
<thead>
<tr>
<th>Task</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fotos incluidos</td>
<td>Entre 25 - 30 fotos, todos relacionados con la tema, cámara en el mismo lugar cada vez.</td>
<td>18-25 fotos relacionados con la tema. Puede que la cámara se movió un poquito a veces.</td>
<td>12-18 fotos relacionados con la tema. La cámara se movió mucho o hay dedos en los fotos.</td>
<td>Menos que 12 fotos. Algunos fotos no salieron bien por el movimiento de la cámara.</td>
<td></td>
</tr>
<tr>
<td>Storyboard</td>
<td>Storyboard salió limpio y organizado, mostrando todos los pasos en la formación de un fósil.</td>
<td>Storyboard tiene los pasos más importantes, pero no tiene muchos detalles o no lo dibujaron con cuidado.</td>
<td>Al storyboard le falta información, está difícil de entender.</td>
<td>Storyboard no explica cómo se forma un fósil, es algo que no se puede leer.</td>
<td></td>
</tr>
<tr>
<td>Trabajos del grupo</td>
<td>¡Bien hecho! Casi todos hicieron sus trabajos, y los otros ayudaron para que el grupo pudiera terminar todo.</td>
<td>El grupo tuvo algunas problemáticas con las responsabilidades, pero cumplieron con el trabajo en fin.</td>
<td>Algunos trabajos importantes no se terminaron por falta de responsabilidad y trabajo cooperativo.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Escenarios y objetos de plastilina</td>
<td>¡Super trabajo! Etiquetas salieron bien, se puede distinguir el fósil muy fácilmente, los colores hacen que todo se ve claro.</td>
<td>Todos los objetos tenían etiquetas que se puede distinguir tanto los fósiles como el resto del escenario.</td>
<td>Faltan algunas etiquetas o no se puede distinguir las cosas claramente.</td>
<td>Faltan etiquetas o están marcadas incorrectamente, no se puede identificar los objetos en la película.</td>
<td></td>
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</tbody>
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APPENDIX C

STEP UP TO WRITING PROCEDURES
Accordion Paragraphs

Use the colors of a traffic signal to help you write a paragraph.

**GO!**
Write a topic sentence.

**SLOW DOWN!**
Give a reason, detail, or fact.
Use a transition.

**STOP!**
Explain. Give an example.

**GO BACK!**
Remind the reader of your topic.
Expository Writing

Organization is the key.

Topic sentences and thesis statements are the heart.

Transitions are the glue for the key ideas.

Examples, evidence, and explanations are the meat.

Conclusions tie it all together.
Párrafos en forma de acordeón

Usa los colores del semáforo para ayudarte a escribir un párrafo.

**VERDE**
Escribe una oración principal.

**AMARILLO**
Da una razón, un detalle o un hecho. Usa una transición.

**ROJO**
Explica. Da un ejemplo.

**VERDE**
Recuérdale al lector el tema de tu párrafo.
Escribir una exposición

Organización es la clave.

Las oraciones principales son el corazón.

Las transiciones son el pegamento.

Ejemplos, pruebas y explicaciones son la carne.

Las conclusiones enlazan todo.
<table>
<thead>
<tr>
<th>verde</th>
<th>Conclusion</th>
<th>amarillo</th>
<th>Razón/Detalle/Hecho y Transición</th>
</tr>
</thead>
<tbody>
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<td>Título</td>
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<th>Oración principal</th>
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<tr>
<th>Razón/Detalle/Hecho y Transición</th>
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<th>amarillo</th>
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APPENDIX D

BACKWARDS DESIGN TEMPLATES
Table 1. The Big Picture of Backwards Design

<table>
<thead>
<tr>
<th>Key Design Question</th>
<th>Design Considerations</th>
<th>Filters (Design Criteria)</th>
<th>What the Final Design Accomplishes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1. What is worth and requiring of understanding?</td>
<td>State Standards.</td>
<td>Enduring ideas.</td>
<td>Unit framed around enduring understandings and essential questions.</td>
</tr>
<tr>
<td></td>
<td>District Power Standards.</td>
<td>Opportunities for authentic,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Teacher expertise and interest</td>
<td>discipline-based work.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Uncoverage.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Engaging.</td>
<td></td>
</tr>
<tr>
<td>Stage 2. What is evidence of understanding?</td>
<td>Six facets of understanding.</td>
<td>Valid. Reliable.</td>
<td>Unit anchored in credible and educationally vital evidence of the</td>
</tr>
<tr>
<td></td>
<td>Continuum of assessment types.</td>
<td>Sufficient.</td>
<td>desired understandings.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Authentic work.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Feasible. Student friendly.</td>
<td></td>
</tr>
<tr>
<td>Stage 3. What learning experiences and teaching strategies promote understanding,</td>
<td>Research-based repertoire of learning and teaching</td>
<td>WHERE</td>
<td>Coherent learning experiences and teaching that will evoke and develop</td>
</tr>
<tr>
<td>interest, and excellence?</td>
<td>strategies.</td>
<td>Where is it going? Hook the students.</td>
<td>the desired understandings, promote interest, and make excellent</td>
</tr>
<tr>
<td></td>
<td>Essential and enabling knowledge and skill.</td>
<td>Explore and equip. Rethink and revise.</td>
<td>performance more likely.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Exhibit and evaluate.</td>
<td></td>
</tr>
</tbody>
</table>

(Wiggins and McTighe, 1998, p. 18)
<table>
<thead>
<tr>
<th>Interpretation</th>
<th>Application</th>
<th>Perspective</th>
<th>Empathy</th>
<th>Self-Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Show and say how electric light work</strong></td>
<td>Design a bridge to withstand specific forces and wave patterns</td>
<td>Compare British and French textbooks accounts of the Revolutionary War to your textbook account</td>
<td>Take on a persona from the Titanic, and create a journal, set of letters, or scrapbook</td>
<td>Keep a log of your reactions to literature and what your reactions reveal about your views of human nature</td>
</tr>
<tr>
<td><strong>Describe why a rhetorical technique is effective in speech</strong></td>
<td>Use the case method in business, medicine, or law.</td>
<td>Read and discuss The Real Story of the Three Little Pigs by A. Wolf.</td>
<td>Imagine you are Juliet from Romeo and Juliet, and consider your terrible, final act. What are you thinking and feeling?</td>
<td>Self-assess your involvement in class discussions and performances, and explain your patterns of participation</td>
</tr>
<tr>
<td><strong>Construct and write a mathematical proof</strong></td>
<td>Write newspaper editorials on the meaning of election results.</td>
<td>Role-play supply-and-demand in a business game.</td>
<td>Role-play a meeting of the minds.</td>
<td>Develop a resume and a description of your intellectual strengths and weaknesses</td>
</tr>
<tr>
<td><strong>Provide conceptual clarification</strong></td>
<td>Draft a Supreme Court decision on a First Amendment case</td>
<td>Make an audiotape of a favorite book for the school library.</td>
<td>Research the impact of welfare-to-work laws on low-income people.</td>
<td>Keep a log of the drama class exercises that demand the most from you emotionally</td>
</tr>
<tr>
<td><strong>Reveal subtle and easily overlooked patterns in phenomena or date.</strong></td>
<td>Do a trend analysis of a finite data set.</td>
<td>Design a museum exhibit on the causes and effects of early 20th century immigration.</td>
<td>Write critical reviews of movies based on best selling books.</td>
<td>Attach a self-assessment each paper you write to the paper as you turn it in</td>
</tr>
<tr>
<td><strong>Clarify the causes of global warming.</strong></td>
<td>Represent fear and hope in a dance.</td>
<td>Conduct statistical analysis of crime trends to predict police staff need in 2010.</td>
<td>Read and discuss literature that confronts you with what is alien.</td>
<td>Reflect on why students often say in class, “I know this sounds stupid, but,” before starting an interesting comment.</td>
</tr>
<tr>
<td><strong>Link everyday action and facts to the laws of physics, constraining on easily misunderstood aspects.</strong></td>
<td>Conduct research using primary sources, and write a historical biography.</td>
<td>Perform a chemical analysis of local stream water to monitor EPA compliance, and present findings.</td>
<td>Self-assess your writing as if you were an editor for a national magazine.</td>
<td>Write a report on why some kids always get picked on and what it feels like to be those kids. Propose solutions to an ineffective cooperative on the basis of what didn’t work in your group.</td>
</tr>
</tbody>
</table>

(Wiggins & McTighe, 1999, p. 152)
Given the targeted understandings or content standards for your unit, brainstorm possible overarching and topical essential questions to stimulate inquiry and guide the unit.

Unit on

Overarching Questions

Topical Questions

(Wiggins & McTighe, 1999, p. 121)

Figure 1. Identifying Essential Questions
Use the following prompts to generate ways that students can reveal their understanding of a topic within a course. The goal is to consider ways that understanding can be shown, not to use every prompt in every facet.

Understanding is demonstrated through explanation, interpretation, and application.

You really understand ___________ when you can . . .

(Unit or course topic)

- Explain/teach ____________________________________________
- Give examples of __________________________________________
- Make connections with _______________________________________  
- Offer a sophisticated theory of ___________________________________
- Describe how _____________________________________________
- Justify/support _____________________________________________
- Provide/verify _____________________________________________
- Avoid common misconceptions, such as ________________________

- Interpret ___________________________________________________
- Make sense of ________________________________________________
- Tell a revealing story of _________________________________________
- Provide an apt analogy for ______________________________________
- Show the importance or meaning of ______________________________
- Translate ____________________________________________________
- Relate _____________________ to your experience (or the experiences of others).

- In a new situation. Apply ________________________________________
- Show or demonstrate __________________________________________
- Use in the context of ___________________________________________
- Design/invent ________________________________________________
- Overcome a challenge or constraint, such as _______________________

(Wiggins & McTighe, 1999, p. 157)

Figure 2. Determining Acceptable Evidence
Use the following prompts to generate ways that students can reveal their understanding of a topic within a course. The goal is to consider ways that understanding can be shown, not to use every prompt in every facet.

Understanding is demonstrated through perspective, empathy, and self-knowledge.

You really understand ____________ when you can . . .

(unit or course topic)

**Perspective**

- Analyze
- See from the point of view of
- Compare and contrast
- Critique
- Critically examine assumptions such as
- Show how
- See the limits of

**Empathy**

- Walk in the shoes of
- Experience directly and see
- Reach a common understand with
- concerning
- Entertain the seemingly odd or alien view that

**Self Knowledge**

- Recognize your prejudice
- Identify the lens through which you view
- See how your habits influence how you approach
- Explain how you came to understand
- Realize that even with all you now know, you don’t really understand

(Wiggins & McTighe, 1999, p. 159)

Figure 2. Determining Acceptable Evidence
<table>
<thead>
<tr>
<th>Questions for the Teacher</th>
<th>Responses from the Teacher</th>
</tr>
</thead>
<tbody>
<tr>
<td>How will you help students know they are headed and why (e.g., major assignments, performance tasks, and criteria by which the work will be judged)?</td>
<td></td>
</tr>
<tr>
<td>How will you hook students through engaging and through-provoking experiences (e.g., issues, oddities, problems, and challenges) that point toward big ideas, essential questions, and performance tasks?</td>
<td></td>
</tr>
<tr>
<td>What events, real or simulated, can students experience to make the ideas and issues real? What learning activities will help students to explore the big ideas and essential questions? What instruction is needed to equip students for the final performances?</td>
<td></td>
</tr>
<tr>
<td>How will you cause students to reflect and rethink to dig deeper into the core ideas? How will you guide students in rehearsing, revising, and refining their work based on feedback and self-assessment?</td>
<td></td>
</tr>
<tr>
<td>How will students exhibit their understanding about their final performances and products? How will you guide them in self-evaluation to identify the strengths and weaknesses in their work and set future goals?</td>
<td></td>
</tr>
</tbody>
</table>

(Wiggins & McTighe, 1999, p. 214)

Figure 3. Unit Design Considerations
APPENDIX E

PERMISSIONS
June 24, 2002:

Catherine Enbody
P.O. Box 580044
North Palm Springs, California 92258

re: DINOSAURS: THE VERY LATEST INFORMATION ... FROM THE MUSEUM-OF THE ROCKIES (Scholastic Professional Books)

Dear Ms. Enbody:

Thank you for your correspondence of June 21 in which you request permission to translate into the Spanish language and reproduce illustrations from the above-named work in a master’s thesis.

Permission is hereby granted on a nonexclusive basis for use of the material on pp. 13, 22, 23, 38, 57-67 from the work for use solely in your master’s thesis. Permission covers use in any copies made for distribution to professors and other examiners.

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Marilyn Small
Director, Rights and Permission
Dear Catherine:

It is our pleasure to grant you permission to use the pages listed below for your masters project. Please state that they were reprinted with permission from Sopris West Educational Services.

Thank you for your interest in our educational products and programs.

Sincerely,

Joanna Huhman

Exec. Admin./Permissions

-----Original Message-----

From: Marty Masters

Sent: Wednesday, July 10, 2002 10:29 AM

To: Joanna Huhman

Subject: FW: Rights & Permissions

Dear joanna,

Good morning!

This lady has asked me earlier if she could use a few Step Up pages for her masters' project. Please log these pages and let her know by e-mail that she has permission. Thanks.

Marty

-----Original Message-----

From: Catherine Enbody [mailto:]

Sent: Monday, July 08, 2002 2:43 PM

To: Marty Masters

Subject: Re: Rights & Permissions

Dear Marty,

The pages I am interested in using come from 101 Reproducible for Beginning Writers (ISBN #1-57035-266-6). I would like to use pages 20, 26, & 44 from the Spanish Edition and the corresponding pages from the English edition (I don't have the English edition in front of me right now, so am not sure if they are exactly the same page numbers or not.

The pages will be digitally scanned into the Appendix of my Masters' project.

Thank you for your help in this matter.

Sincerely,

Catherine Enbody.
Dear Catherine,

ASCD hereby grants you permission to digitally scan the following material which is copyrighted by ASCD.


Permission is given on the condition that you:

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Sincerely,

Christine Richards
Permissions Specialists
Hi Catherine,

Michelle was not able to email you due to a family emergency that ended with her spending many hours at a hospital. We both agree to you using our materials as I had previously stated. Could you also send us a copy of the translated versions?

Thanks,

Eva LaMar

At 10:45 AM 7/16/02 -0700, you wrote:
>
> Eva,
> > Hoping Michelle is back in town now. Just sending this as a reminder
> > about the permission to use the group planning sheets for the claymation
> > project within the context of my Master's project. I am trying to turn in
> > the first draft tomorrow afternoon, Wednesday - so I would really
> > appreciate it if you could send me back an e-mail with permission ASAP.
> > Thanks very much - your devoted fan in claymation,
> > Catherine Enbody
> > 
> > At 12:59 PM 7/8/02 -0700, you wrote:
> > > Dear Eva,
> > > I attended your presentation on Clay Animation at the Spring CUE
> > >> conference and loved it. I am currently working on my Master's project in
> > >> Instructional Technology and am outlining a unit of instruction on
dinosaur and fossils which will include the use of some of your cooperative learning planning sheets from the website. I have translated the group planning sheet, the group responsibilities posters and the camera planning sheets into Spanish, as I work with a bilingual class. I would like to use both the English and Spanish versions within the context of my Master's project. This e-mail is to request permission to use those documents in my project. My address is:

Catherine Enbody

Thanks very much for your assistance.

Cathy Enbody
APPENDIX F

INTERNET RESOURCES USEFUL TO THIS PROJECT
Dinosaur Clip Art

http://www.countryfriends.org/KWClipArtFeb.html
http://www.kidsdomain.com/brain/dino/clip1.html
http://members.lycos.nl/dinosaurs/clipart.html
http://www.geocities.com/SOHO/Village/4040/dinosaurscol.htm
http://www.enchantedlearning.com/subjects/dinosaurs

Rubrics

http://www.rubistar.com

Clay Animation

http://napanet.net/~lotus72/claymation/

Schools of California On-Line Resources for Education (S.C.O.R.E.) website

http://www.score.k12.ca.us/

California Technology Assistance Project (CTAP) Website:

http://lacoe.edu/ctap
REFERENCES


