EDUCATIONAL TECHNOLOGY PRIMER

A Guide for Pre-Service Teachers

Educational Technology Primer
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Preface

The Educational Technology Primer grew out of the realization that today's teacher education students have different needs than their predecessors. Current students arrive on campus less intimidated by technology and more experienced with the use of technology in instruction. However, many introductory educational technology texts still highlight the acquisition of basic technology operations; knowledge and skills that made sense when students entering an introductory educational technology course lacked technology experiences, but not today.

Even though the technology skills of pre-service candidates have improved, current students are still novices when it comes to integrating technology into instruction. So, how does one bridge the gap between the novice pre-service teacher candidate and the teacher who is a technology-using expert? This was the question that led the authors to adapt ideas from the Technological Knowledge, Pedagogical Knowledge, and Content Knowledge (TPACK) framework for the Educational Technology Primer. In the TPACK framework, teachers who are successful at integrating technology understand the complexities of their content area, the teaching methods that work with their students and how technology impacts instruction. TPACK frames technology integration in pedagogy and content acquisition, a context familiar to experts. Unfortunately, novice pre-service candidates lack an expert's context for teaching. The Educational Technology Primer addresses context by embedding technology within the instruction of teaching methods. As such, pre-service candidates have a rationale for technology integration, while improving both their pedagogical and technological skills.

The shift of emphasis from technology skill acquisition to technology integration couched in pedagogy requires a departure from the knowledge and skills focus of prior educational technology textbooks. The Educational Technology Primer accomplishes this shift by introducing technology integration techniques across common instructional approaches. Each chapter explains an instructional approach found in K-12 settings. Baseline information on how to plan, implement and evaluate the instructional approach is presented. The benefits of the approach are described along with techniques for integrating technology, technology how-to information, web resources and suggested activities.

The chapters vary in emphasis. One chapter may focus on the steps for implementing an instructional model and provide examples for technology integration, whereas another chapter may focus on how-to techniques for using and integrating technology in the instructional approach. Chapter 1 provides an introduction to educational technology with a focus on basic technology operations and Internet use. Chapter 2. offers guidelines on how to use technology to effectively communicate class presentations. Methods for creating graphic handouts, along with methods for using graphics in instruction are presented in Chapter 3. In Chapter 4., an overview of direct instruction is presented along with technology implementation techniques. Advance organizers, particularly graphic organizers are described in Chapter 5. Data collection and analysis approaches, including inductive techniques that are difficult to conduct without technology are considered in Chapter 6. In Chapter 7., an inquiry approach is detailed along with methods for supporting inquiry with technology. Process writing instruction is outlined in Chapter 8. This chapter points out how technologies may be integrated into the writing process. Chapter 9 describes Problem Based Learning techniques and how the use of technology enriches the approach. Chapter 10. Explains how technology may be integrated into instruction to increase both student and teacher creativity. The text concludes with appendices for readers with limited or no prior knowledge on other technology and instructional topics. The goal of the Educational Technology Primer is modest; to provide students with technology integration skills that they can implement during initial teaching experiences.

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Introduction

As you move through your educational program, you will learn subject matter content as well as specific instructional strategies. Along the way, you will become knowledgeable about how people learn, how to manage your classroom, how to design instruction, and the many complexities of teaching. You will develop your own pedagogical style. That is, your knowledge, beliefs, and experiences will shape your approach to teaching.

One aspect of teaching this text helps you learn about is technology integration. From searching the Internet to creating a class Wiki, teachers and students use technology on a daily basis. Many educators continually strive to develop and refine effective and efficient ways to integrate technology into the learning process. Technology has become an important, and some would say essential, aspect of education.

There are multiple ways to integrate technology into your teaching practice in support of learning. This chapter reviews several different perspectives and describes the basic knowledge and skills required for technology integration.

Technology as tutor, tool, and tutee

Early in the development and use of technology in education, one approach to technology integration was to classify technology into categories. One of the most influential models using this

approach is detailed in a 1980 book by Robert Taylor, entitled, The Computer in the School: Tutor, Tool,Tutee. Three aspects of computer use were investigated and defined. Taylor defined the computer as tutor, to mean any application that has been designed and developed by an expert to teach a particular subject or topic. Examples of software applications that act as tutors are programs that students use to learn something and then practice what they have learned, such as Mavis Bacon Teaches Keyboarding, Math Blasters, and the Virtual Rain Forest.

Viewed as a tool, the computer serves a particular function such as word processing, data analysis, or image manipulation. In this way, computers can increase productivity making tasks easier and quicker to accomplish.

When used as a tutee, the computer is programmed or structured by the student or teacher to do a task or to respond in a specific way. When students or teachers use technology to write a small program to make objects move in certain directions, for example, they are using the computer as a tutee (in essence, the computer is learning to do something based on what the student or teacher instructs the computer to do). Scratch, a programming language that lets you create stories, animations, and games, is an example of how a computer can be used as a tutee.

Technology Skills

Growing out of Taylor's work, the focus of learning about technology shifted to the belief that all teachers and students should be knowledgeable in specific technology skills. From this perspective, educators were encouraged to become proficient in word processing, spreadsheets, databases, e-mail, and presentation tools so that they could teach students these skills.

Educators found that although this approach helped to increase technology skills, technology was not necessarily being used in meaningful ways in the classroom to help students learn. Today, most students have baseline technology skills. It is likely that you have developed competence in word processing and have created computer presentations in software such as Power Point ®. Some of you have probably used graphics programs or photo manipulation software while others of you may have created spreadsheets and graphs for class assignments. As a pre-service teacher candidate, you do not need to be a technology expert, but basic knowledge and skills with word processing,

presentations, graphics, and spreadsheet software form the pre-requisite skills of technology use required for understanding this text. Fortunately, there are numerous self-paced tutorials available to learn these basic technology operations. Many tutorials are available for free online.

The Internet

The Internet expanded during the first decade of the 2000s, to the point where access is available in almost all K-12 schools in the country. Home use has increased geometrically and so have the Internet skills that students and teachers bring to the classroom. In addition, the range of software applications and content related materials available on online increases daily. The Internet offers benefits that were unheard of a generation ago, including instant access to current and historical information and data; step-by-step tutorials, pictures, videos, and animations on almost any topic; and an overabundance of content-rich information about any topic imaginable. Along with these benefits, the Internet poses problems for educators. Some content on the Internet is inappropriate for schools. Unlike textbook content, much of the Internet content has not undergone any form of professional editorial review. In other words, there are problems with the accuracy and reliability of Internet sources. In addition, the reading level of Internet text spans a range from beginner to expert, so students may encounter content that is beyond their reading level. And finally, the quality of web writing varies considerably.

TPACK Framework

Mishra and Koehler (2006) published a conceptual framework for educational technology in teacher education. The Technology/Content/Pedagogical Knowledge (TPACK) framework places at its core, the intersection of technology knowledge, content knowledge and pedagogical knowledge. Their goal was to provide a theoretical grounding for educational technology. For individuals new to educational technology, the TPACK framework offers a mechanism for examining the baseline knowledge, skills, and dispositions essential to the meaningful integration of technology in instruction.

Simply stated, the TPACK framework explains what we know intuitively. Expert teachers understand their content area and when teaching content, expert teachers employ specific pedagogy - teaching strategies, methods and techniques

to address the unique knowledge and skills required to understand the content. Lastly, expert teachers who integrate technology into their teaching understand how technology supports pedagogy and improves the acquisition of content knowledge and skills.

The TPACK framework, in addition to providing a theoretical grounding, offers a practical organization of the knowledge, skills, and dispositions necessary to prepare teachers to integrate technology in a manner consistent with learning goals. This text uses the TPACK framework to introduce technology integration.

Prerequisite Knowledge

This introductory chapter identifies the baseline technology knowledge and skills necessary for the integration of technology into instruction. Pre-service teacher candidates are not expected to have the expertise of experienced teachers. In the subsequent chapters, our strategy is to present common instructional approaches along with the planning and implementing information required to integrate technology into the approach.

Many excellent online tutorials and examples of how different technology tools may be used in the classroom are available. Using Google and typing in search terms such as "word processing tutorial" or "spreadsheet tutorial," results in thousands of web sites. Many excellent educational technology textbooks have also been written that provide step-by-step tutorials.

The following table lists technology skills required for understanding and using this text.

TABLE 1
Prerequisite skills

Skills	What you need to know
File operations	Know where your files are located on your computer or how to find them Know how to open and close documents and applications Know how to save, rename, and delete files
File extensions	Know common file types including .doc, .xls, ppt, .htm, and .jpg

TABLE 1
(Continued)
Prerequisite skills

Skills	What you need to know
File organization (organize, copy, move, delete)	Know how to keep your computer files organized Know how to create folders, organize folders, and move and copy folders and files
Printing	Know how to select a specific printer Know how to print all or portions of a file
Word Processing	Know basic text formatting skills including how to select a font, font size, bold, italicize, align text, insert graphics/clip art/ hyperlinks, format paragraphs, use tabs
Presentations	Know how to create and organize slides sequentially Know how to insert graphics in a slide Know how to view slides in multiple formats including slide sorter, outline view, notes pages) Know how to print slides in multiple ways (individual slides, handouts, notes pages)
Graphics	Know how to use standard drawing tools – lines, objects, text and eraser tools
Spreadsheets	Know how to enter data in a spreadsheet and graph the results Know how to label columns and rows Know how to use common functions such as SUM, AVERAGE, MIN, MAX, and TODAY
Internet Skills	Know how to conduct a basic search using keywords Know how to download files Be aware of Internet safety issues

Chapter 1

Presentations

Communicate the Message

Presentations are common in K-12 settings and the reasons for their use are numerous. Teachers use presentations to introduce facts, to review previously taught information, and to model the acquisition of skills. Instructional methods for presentations include lecture, storytelling, demonstrations, visual explanations, and step-by-step directions. Given such a wide range of possibilities, presentations often differ in technique, tone, and delivery. However, despite these variations, educational presentations always have the goal of communicating a message to a specific audience. This chapter provides guidelines for creating presentations that communicate a message and describes key issues to consider when using technology to plan and implement a presentation.

What are classroom presentations?

Classroom presentations imply instructional situations where a teacher communicates to a live student audience. Classroom presentations differ from online presentations because the presence of a teacher changes the dynamics of how content is presented. In an online presentation, the content is typically scripted and recorded for playback. In a classroom presentation, while the content is also carefully scripted, the teacher interacts with the content and the students, shares information, gauges student understanding with questions, and adjusts the level of detail and explanation accordingly. Presentation interaction techniques will vary from teacher to teacher and across content, grade level, and audience, but the goal of communicating an educational message remains constant. From this point forward when we use the term "presentation" we mean live presentations by an instructor, not online presentations.

What are the benefits of presentations?

Presentations have a long history in K-12 education and both teachers and students are familiar with presentation approaches. In traditional instruction, presentations are used to introduce new information. Technology-assisted presentation software such as PowerPoint® allows teachers to create logical and sequential presentations. The ordered, slide-by-slide approach makes it easier for students to follow a presentation and to remember key facts. Teacher directed presentations make efficient use of instructional time by focusing on content that supports lesson goals. Presentations also work well for the review of content taught via other instructional methods. From a practical standpoint, technology-assisted presentations may be saved for future use, easily revised, printed, and shared with students. Students may also use presentation materials as note taking or study guides.

How to plan presentations

In our explanation of presentations we focus on sequential slide presentations common to PowerPoint ® and other computer applications.

Prior to planning a presentation, it is essential to know your audience and to know the message you wish to communicate. Teachers determine the message of the presentation by first identifying the learning outcomes of a lesson. Lacking a clear vision of what the students already know, and how the students will be different after the presentation, a teacher may have a difficult time determining what to include in a presentation. If students lack prior knowledge about a topic then the teacher begins with the basics. If students have a basic understanding of the content, the teacher may begin with more advanced content.

Prerequisite knowledge is defined as the information, knowledge, and skills a student needs to possess in a particular content area in order for that student to comprehend new information in that content area. An example of prerequisite knowledge is having an adequate understanding of addition prior to learning subtraction. If students do not have an adequate understanding of addition, as well as knowing what a word such as 'opposite' means, then trying to explain subtraction as 'the opposite of addition' will be difficult for students to grasp.

One way teachers may ensure that students have the necessary pre-requisite knowledge is to use an advance organizer (See Advance Organizers, Chapter 4.) Advance organizers tie new content to students' existing knowledge by presenting an initial overview of the content under consideration.

Despite variations in presentation types, planning an educational presentation should include a consideration of:

1. Audience
2. Message(s) to communicate,
3. Order of presentation,
4. Delivery medium,
5. Design and layout, and
6. Supporting media.

1. Audience

Every presentation begins with an understanding of the audience. What does the audience know about the topic? What is their reading level? Is the audience motivated to learn about the topic? There are many questions to consider when analyzing the audience and the more you know about the intended audience, the easier it is to tailor a presentation to the audience's needs.

2. Message

The single most important aspect of any educational presentation is the message. In most instances the message is based on the learning outcomes the teacher has identified for the students (See Appendix 1). Working backwards (Wiggins & McTighe, 2005) from the learning outcomes to identify the knowledge and skills that students must acquire is a practical method for organizing the content that supports the educational message.

How do you know what the message is?

The goals and objectives of your lesson describe your learning outcomes. By working backwards from the learning outcomes, you can identify the message and supporting details. For example, you may have a learning outcome where you want students to list the causes of the American Revolutionary War. In this example, the outcome describes facts and information – the list of causes. To simplify understanding, you need to determine a sequence for presenting the causes and supporting details in a manner emphasizing cause and effect. Each detail and the order of the detail in the presentation should contribute to the learning outcome. Providing the data alone is insufficient. An effective presentation provides data with stories and stories with data.

3. Order of Presentation

The decisions you make regarding the order of slides can be critical to understanding. Each slide needs to build upon the preceding slide to deliver a coherent and unified presentation. The logical and sequential order of a presentation will make a difference in the overall message.

Like a paragraph in a narrative, each slide in a presentation contains one main idea with supporting details. Practical benefits of limiting slide content to one idea include; reducing the memory load for the students, providing a focus for interaction with students and presenting sequenced ideas for informal assessment of student understanding.

4, Delivery Medium

Presentational delivery methods abound. Every day, new computer applications become available to assist in the production of presentations. PowerPoint ®, KeynoteTM, and Google Docs Presentation represent applications commonly used in K-12 instruction. The decision to use one presentation application versus another has more to do with your familiarity of the software than with its functionality, since the aforementioned applications and numerous other programs support the integration of media (text, audio, graphics and video) into presentations.

Much has been written regarding the role of media in communicating a message (McLuhan, 1964) and supportable arguments may be made regarding the impact of media on the message. Today, many computer-generated presentations include effects, transitions, sounds, images, video, and animation. The computer-generated media gets students' attention, but oftentimes this media distracts students away from the academic content. As a result, media may undermine the educational purpose of your message.
To avoid potential distractions caused by the media, it is important to focus on the message, content, organization, delivery and audience. Although instructional media is considered in the planning and implementation of a presentation, the educational message is more important than the use of flashy media.

5. Design and Layout

Aesthetics plays a role in presentations. However, your design and layout considerations should focus on readability, contrast, consistency, and simplicity. Overall appearance and aesthetic will be improved by adhering to basic presentation guidelines. Also, once you understand basic design guidelines, you will be better equipped to know when to bend the guidelines to improve communication of your message.

6. Supporting Media

Most students have seen presentations filled with graphics, animations, sound effects, and transitions. In some instances these media packed presentations are entertaining. Unfortunately, in many media packed presentations, the media actually distracts the audience from the message. A competent presenter is able to determine when audio, video, animation, graphics, effects, and transitions support the message, and when they serve as a distraction. As a rule of thumb, media should not be included in a presentation if it does not help to communicate the educational message.

Guidelines for classroom presentations

Elements to consider in the design of presentations include restraint, readability, contrast, typeface, organization, media and effects, and transitions. These elements are interrelated and together they contribute to the design effectiveness of a presentation. Understanding the purpose of each element and using basic guidelines for addressing each one makes it easier for you to implement good design decisions.

Restraint

Software application user guides and tutorials for presentation software emphasize technical aspects of the software rather than communications techniques. As a result, users learn how to use the functions available in the software. However, having the technical expertise to use a particular function does not guarantee that a presentation will communicate your message. It is easy to become seduced by graphics, sounds, animations, and video options that are available in presentation software packages. However, just because a feature is available doesn't mean it should be used. As such, novice educational presenters should accept restraint as an underlying principle for presentation design. Restraint means avoiding the features, media, and "bells and whistles" that do not contribute to the educational message of the presentation. (See Figures 1 & 2)

FIGURE 1
Good Example of Restraint

FIGURE 2
Poor Example of Restraint

Readability

Readability Rules: 3-5 bullet points per page, separation between lines of text, text large enough to read (36-24 points).

Readability is about text. Text allows you to communicate key information in a clear and concise manner. There are numerous ways to present text. The simplest guideline is to use text that is large enough to be seen by everyone in the audience, not just those seated in the front row. As the amount of text on a slide increases, the size of the typeface to accommodate the text is reduced and so is readability. One method to reduce text overload in a presentation is through the use of bullet points and short phrases. Bullet points can support readability by chunking text into manageable portions, separating the message of a slide into supporting details, and limiting the text to essential information. Most people are capable of remembering three to five items in short-term memory. Therefore, limiting the number of bullet points to three to five bullet points per page can reduce the memory requirements of students while increasing readability.

A common "bad" presentation practice is to fill a slide with bulleted sentences rather than short phrases. The sentences fill up the available space, decreasing separation between words and reducing readability. Text overload occurs when too much information is placed on a slide. (See Figure 3.) In addition to an over-packed slide, providing complete sentences may lead the presenter to read to the audience, a technique that is seldom effective. Slide text should serve as a memory aid for the presenter, not a teleprompter.

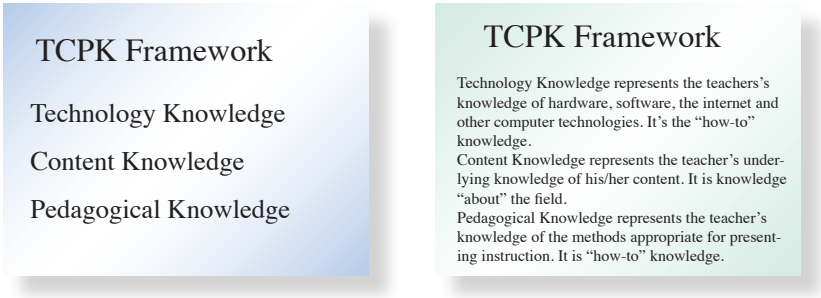


FIGURE 3
Bullet Points vs Crammed Text

Another good practice is to create handouts to complement the key content provided on the slides when your learning outcomes include student acquisition of facts and information. To maintain audience attention, it is a good rule to limit the handout to a note-taking guide, or to provide a detailed handout after the presentation is completed.

Legibility • Typeface

The options for typefaces seem infinite. There are serious, plain, comical, and stylized typefaces. Choosing one can be daunting. In general, novice presenters gravitate toward serif fonts, such as Times New Roman because the fonts are familiar and the curves and embellishments on individual letters look crisp when viewed on a computer screen and in print. Depending on the quality of the projector used and the lighting of the room where your presentation occurs, the crispness of serif typeface can be degraded when projected. San serif fonts, such as Arial, have block like edges making digital projection sharper. For this reason, a safe choice is one of the many sans serif typefaces available.

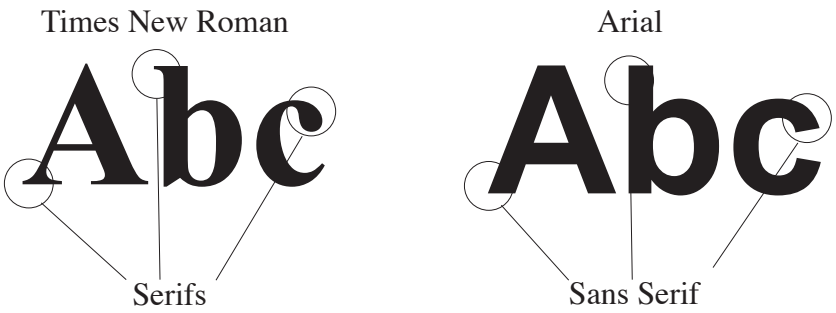


FIGURE 4
Serif vs San Serif text

In addition to typeface selection, the use of ALL CAPS can be a problem. Avoid typefaces that lack a lower case font option. ALL CAPS is useful to emphasize a word or short phrase. However, when used extensively, ALL CAPS leads to blocky text with limited letter differentiation, complicating readability. Stylized text such as Bold, Italic, Underlined and Shadow should be used for emphasis only, otherwise, like ALL CAPS, these options reduce readability and distract from the message. Selecting an appropriate typeface and limiting text to short phrases will increase readability. You may then focus on explaining the essential information and engaging the students in your message.

Questions for text selection include;

Size – is the text large enough to read?
Type – what tone (serious, comical, formal, informal) does the font suggest? Is this tone consistent with the presentation message? ? Is this tone consistent with the audience?
Style – How does the style contribute to understanding?
ALL CAPS - Does the typeface provide upper and lower case letters?

Compatibility – Different computers have different fonts installed. If you choose a less common font will it be on the computer that you plan to use?

Contrast

Contrast involves differentiating elements on the slide to obtain an effect. Two common uses of contrast are 1) to increase readability and 2) to draw attention. Choosing high contrast colors for foreground text and background will make the text easier to read. For example, using black text on a light yellow background or white text on a dark blue background provides a high level of contrast. The key is to have sufficient contrast between foreground text and background so the text stands out. Contrast is useful for drawing attention too. A single word in boldface style or in a color different from the body text draws the audience's attention. (see figure 5) However, having all the text in boldface or the same color does not provide differentiation. Increasing the size of the text in a word or phrase draws the audience's attention, whereas increasing the size of all the text does not increase contrast and may clutter the screen.

FIGURE 5
Poor contrast vs.
Good contrast

Organization

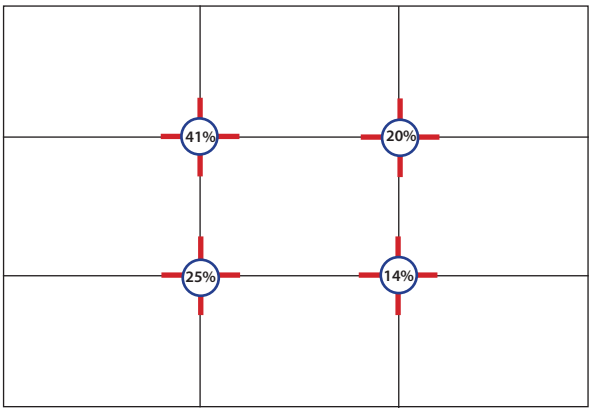
There are two organizational schemes in presentations. The first type of organization relates to the logical and sequential presentation of the content. This organization is based on the learning outcomes and is contingent on the instructional decisions that are specific to a particular lesson.

A second type of organization deals with design and layout issues common to all presentations. Consistent design and layout contribute to the coherent appearance of the slides throughout a presentation. Graphic elements such as grids, borders, and shapes need to adhere to alignment, consistency, and repetition principles in order to contribute to a unified design and layout. Most computer presentation software provides layout templates to assist with design and layout organization. The software slide templates range from blank to highly complex. For educational purposes, simple layouts that emphasize meaning over appearance and layouts that offer uncluttered presentation of content are preferred. As a general rule, left justified (aligned) text works best with bullet points. The grid may be used to establish consistent borders to frame the content. Borders prevent the appearance of the content being pushed off the slide. Used across slides, the design and layout elements contribute to a consistent appearance. Consistency makes your presentation more professional, and more importantly, consistency makes it easier for students to follow the presentation.

Rule of Thirds

The 'rule-of-thirds' is a principle of photographic and graphic composition in which an area is divided into thirds both vertically and horizontally and the centers of interest are located near the intersections of the lines. Research on eye movement indicates that people from Western cultures tend to look at the upper left-hand area of a visual first. Eye movement then tends to move to the right and then to the bottom. The numbers at the intersections that divide the image into thirds indicate the percentage of people that look at that intersection first when viewing a graphic. (See figure 6)

FIGURE 6
Rule of Thirds



Keeping these eye movement principles in mind, place important information near one of the intersections of the dividing lines and place the start of the main message where the eye first strikes the area (the 41% area) . If the nature of the design puts important information in the lower left portion, then design elements or objects need to lead the eye to where that information is located.

There are no objective guidelines for determining if layout elements work together in a design, but subjectively, you should be able to examine each slide and decide if each slide looks as if it belongs to the same presentation. When slides meet this subjective test they have an integrated and professional look and feel.

Media

Text works well as a delivery device for some content, but not all. Charts, graphs, pictures, animations, videos, audio, and other media may be used to share complex concepts in a simple, yet interesting format. The decision to include media should be based on the answer to the question, "Does the media contribute to the educational message?" If the answer is yes, then the next step is to verify that the media can be projected so that it is large enough for all students to see the visuals and/or hear the audio. Care must be taken not to stretch graphics disproportionately or to enlarge graphics to the point where the images become pixilated.

FIGURE 7

Pixelated graphics

Pixelated

Non-Pixelated

Presentations with large quantities of media should be tested with the computer and projector that will be used to present them to ensure the presentation is projected and working as designed. When possible, test the projector in the room where the presentation will occur, as lighting may impact the quality of the media presentation. Lastly, gratuitous media only serve to distract the audience from the content. This form of media should be avoided.

Effects and Transitions

Current presentation software applications offer a wide range of visual effects and sound effects as well as transition options between slides. Like media, effects and transitions should be used purposefully. The fact that the software provides multiple effects, wipes, dissolves, and pushes does not mean that they have a place in an educational presentation. Only effects and transitions that contribute to the delivery of the message should be employed.

Consistency is the primary guideline for the use of transitions. You should apply the same transition across all slides unless you wish to draw attention to a specific slide or slides. Changing transitions without reason may lead to increased audience attention, but the audience attention is directed to the transition rather than the content. Like transitions, effects come in many varieties. An appropriate use of effects is to apply an effect to slides with bullet points. Having each bullet point appear one at a time on a slide allows the presenter to explain each bullet point individually. Using the one-bullet-point-at-a-time approach may encourage your audience to listen to the explanation of each point instead of reading subsequent points and missing part of your explanation. You should avoid sound effects unless they contribute to the meaning of the message. A planning checklist is provided in Appendix 2. Presentation Tools.

How to implement the Presentations

The effective presenter knows it is not sufficient to simply deliver facts and information to an audience. Rather, the presenter considers opportunities for audience interaction, including posing questions to students, seeking student explanations of new information, acknowledging student understanding, and turning the facts into stories. The benefit of weaving facts into a story is that stories provide students with an easier way to remember the content. Interacting with the audience reduces the tendency for the presenter to become a "talking head." It is critical that you engage your students in order to communicate your educational message and help students achieve the learning outcomes.

Unlike some of the instructional approaches presented in this text, presentations are not a separate model of instruction. Instead, presentations are common to many instructional approaches. For example, in direct instruction you might review content or introduce new content using a presentation. In an inquiry lesson, you might use a presentation to present a problem for student solution. In a process-writing lesson, you might use a presentation as a springboard for generating writing ideas. Presentations are used in many types of instruction. How you implement a presentation may differ based on the specific instructional model in which it occurs. Therefore, the specifics of how to implement a presentation will vary. However, some general guidelines are available.

Prepare the Room	
1	Place the screen where the entire audience may see the presentation.
2	Check the projection device, computer, and connections in advance.
3	Place equipment cables where they are not a safety hazard..
4	Load and test the presentation file and software on the expected equipment.
5	Check the audience's view of the presentation - (lighting, size, picture distortion, etc).
6	Determine instructor locations for the presentation.
7	Open and minimize the presentation file (eliminates loading wait time).
8	Save a backup file to alternative media (USB drive, CD-ROM, etc).

Prior to Presentation

1	Review the questions and comments you prepared for the presentation slides.
2	Copy any handouts (if required) and have available for distribution.

During the Presentation

1	Explain the purpose of the presentation at the outset.
2	Have notes available for each slide to make sure you do not forget important content. .
3	Avoid reading the text on the slides unless quoting a phrase, sentence or passage.
4	Interact with the audience – ask questions, clarify content, seek explanations..
5	Review key points.
6	Summarize materials.

After Presentation

1	Provide handouts (if required).

How to evaluate the presentations

Since presentations are not a separate instructional model, the evaluation of their application in instruction is tied directly to the instructional model in which they occur and the learning outcomes of the lesson. However, guidelines for the evaluation of technical aspects of the presentation are the same as the ones indicated in planning presentations. For ideas on how to evaluate a presentation see the Presentation Rubric in Appendix 2.

How can technology support the implementation of presentations?

Free online applications and traditional software applications such as PowerPoint® make it possible for you to create and modify presentations both quickly and easily. Technology also allows you to save and share presentations. After classroom instruction, a presentation may be printed as a handout. Internet sites provide free storage options so you may want to upload your presentation, which makes it available to your students outside of class for review purposes. Current software applications provide options to include audio, video, and animations. Appropriate media will help your students understand the content better. Even narration may be added so that the presentation may stand alone, as in a simple tutorial. Once you have learned the basic software operations, the options for utilizing technology in presentations are limitless.

Technology – How- to

In order to use technology well, it is important to be familiar with your presentation software. Consider completing a basic tutorial if you are not familiar with your presentation application. Numerous tutorials are available online. Developing technical competency with presentation software will help you keep your focus on the message. In this how-to activity you will walk through the steps for planning a presentation for a biology lesson at the secondary level.

The key information you want students to know when the presentation is over is that the hereditary traits of individual animals that live long enough to reproduce are more likely to appear in future generations than the traits of the animals that do not live long enough to produce offspring.

Your audience is a high school biology class. They have learned the basics of hereditary genetics. They know that traits are passed from parent to child via the parents' DNA.

The tone of the presentation will be serious, as even mentioning reproduction to a secondary audience may take them off subject.

You could search the Internet for source information, but information from a class experiment might be easier to explain and the students may be more interested since they participated in the experiment. For this how-to activity, assume that tenth grade students were placed in groups. Each group took on the role of predators of the same species. However, variations existed within the species. One type of predator used forks, another knives, another spoons, another chopsticks, and the last variation of the species used tape to collect prey. The students went to a lawn where beans and seeds were scattered as prey. Each group was informed that they had one minute to collect prey using only the type of tool provided to their variation of predator. Individuals who collected enough prey to eat during the time interval survived. Those that did not collect enough perished. A formula was applied after each collection period to determine how the variations were expressed in the next generation. For example, the fork variation was successful at collecting enough prey to eat to survive, so the number of fork predators increased in the following generations. The chopsticks predators were not successful at collecting enough prey to eat to survive, so their numbers decreased in the next generation. The process of collecting prey and resetting the predator populations was repeated through three time intervals or three generations. Data documenting how the predator populations changed from generation to generation was stored in a spreadsheet.

The presentation would occur the day after the experiment. To cue the students to what is important, you would begin the presentation by reviewing the experiment.

Collect and prepare the content.

Preparing the content can be time consuming. However, in this example the data was collected during the predator experiment so you only need to prepare the content. The raw data in the spreadsheet is in chart form in Appendix 2. Describing the data in the chart will help the students to understand the results. Converting the chart data to a graph might make it easier for students to see the trends. Asking students to explain the graph will help you know if they understand. Questions on the graphed data should be prepared in advance. For example, "What species variation is likely to survive, and why?" "What species variation is likely to reproduce?" and "What variations are less likely to be expressed in the next generation?" should be prepared in advance.
To ensure understanding, students should be asked to apply their explanations to other examples. Lastly, restating the key message for students will provide them with a generalization to considering biological change. By thinking through what you want the students to know, you have established a sequence for your presentation – review, describe, explain, apply and restate. What you present and how you present it will vary with your learning outcomes.

The next step is to create a draft of the presentation using thumbnail sketches. (See Figure 8.) Thumbnail sketches are quick sketches that identify the presentation slide content. Creating them with paper and pencil is a way to keep the focus on the lesson's message rather than the presentation's appearance.

FIGURE 8
Thumbnail sketches

Now that you have a clear idea of lesson's message, you are ready to determine the design layout. This presentation is brief because the message is focused. The content is a mix of text and graphics so a simple design that supports text and graphics was selected.

The primary planning work is complete. Next comes adding content. This is the point where you open your software application to create the actual presentation slides. The benefit of waiting until this step is that you have a clear idea of how the presentation is to proceed. At this point we assume you are familiar with your presentation software or an online presentation program. Your task is to recreate the following slides. Note, for this example a Master slide was created in PowerPoint® with two horizontal lines to frame the area where the content will appear. Depending on your software, your version of the presentation may not be identical to the examples.

Slide 1 – Title Slide

The first slide introduces the topic to the students. The subtitle is included to cue the students to the three key concepts surrounding biological change. (see figure 9)

FIGURE 9
Title Slide
Font: Sans Serif/Arial

Slide 2 – Review the experiment.

In addition to providing the slide, you would elaborate on the purpose of the experiment and ask questions regarding the students' experiences as a type of predator or why one prey was easier to collect than another. (see figure 10)

FIGURE 10
Review Slide
Font: Sans Serif/Arial

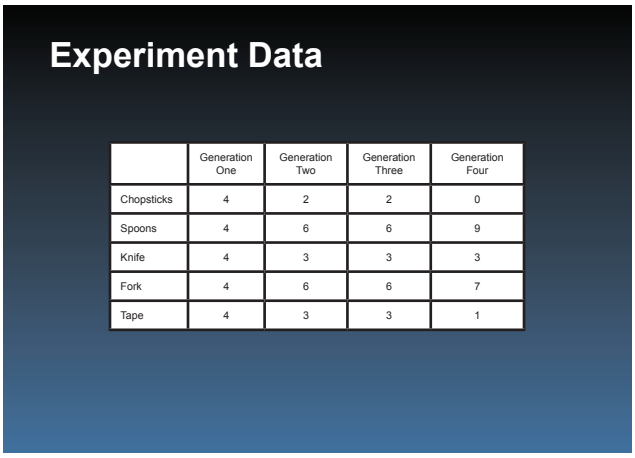
Slides 3 and 4 -Describe and Explain Results.

The chart and graph on the slides were copied from a spreadsheet used to collect data during the experiment and pasted into the slide. Downloadable copies of the chart and graph are available in Appendix 2. During the presentation remember to ask students to explain how these results occurred. (see figures 11 & 12)

FIGURE 11

Experiment Data Slide

Font: Sans Serif/Arial

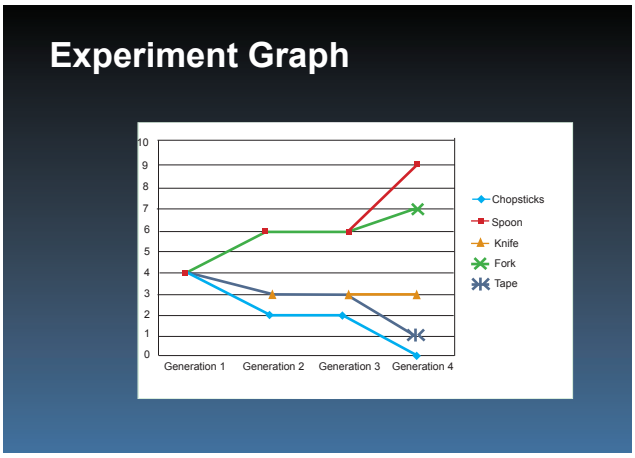


	Generation One	Generation Two	Generation Three	Generation Four
Chopsticks	4	2	2	0
Spoons	4	6	6	9
Knife	4	3	3	3
Fork	4	6	6	7
Tape	4	3	3	1

FIGURE 12

Experiment Graph Slide

Font: Sans Serif/Arial

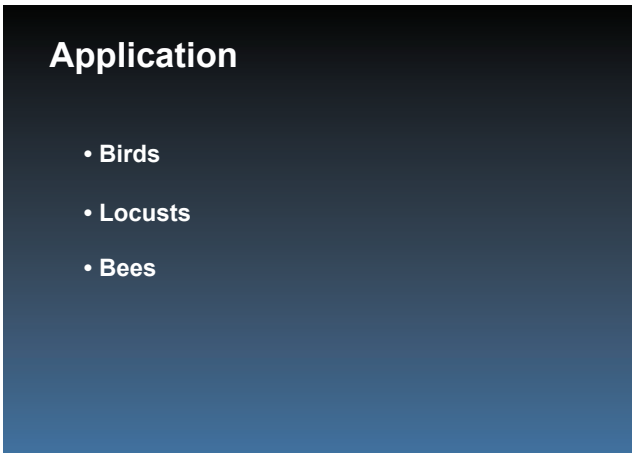


Slide 5 – Apply Knowledge.

For this activity you would either read each question or provide the students with a handout of the questions because you would have to use a small typeface in order to fit an entire question on a slide and then students would not be able to read it.

See Appendix 2 for sample questions.

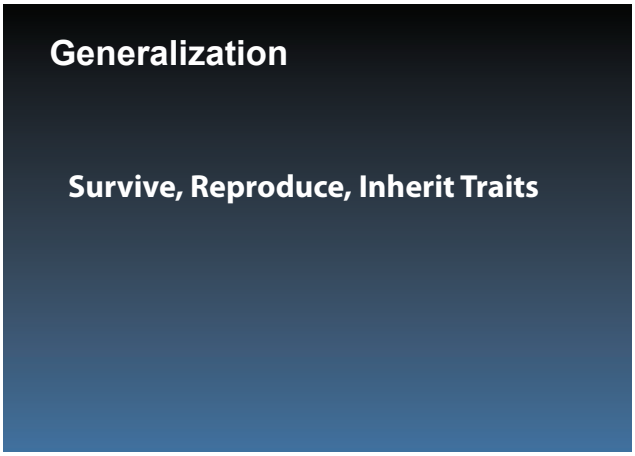
FIGURE 13
Question Slide
Font: Sans Serif/Arial



Slide 6 – Restate the Message.

Now that students have applied their knowledge, you may conclude by restating the key biological change message.

FIGURE 14
Summary Slide
Font: Sans Serif/Arial



You are never really done with a presentation. You will learn what works and what needs improvement by testing it with your students. You will then revise it and archive it for subsequent classes.

Web resources for Presentations

The Internet offers resources for planning, creating, saving, and sharing presentations. Free online applications are available to create presentations. Fair use media such as photos, clip art, animations, and video may be found by conducting Internet searches. Several sites are available to post presentations for student review or for projection in class. In addition to resources to produce presentations, the Internet offers many software-specific tutorial sites as well as instructional sites for designing and evaluating presentations. Sample Internet resources are listed in Table 1. An online search will provide numerous other options.

TABLE 1
Web Resources

Type	Resource
Online Presentation Applications	Google Documents, Slideshare, Zoho Show, Prezi
Fair Use Information	CONFU – the conference on fair use provides practical guidelines for using media in classroom instruction.
Instructional Information on Presentations	Slideshares - Death by PowerPoint and Really Bad PowerPoint by Seth Godin provide arguments for improving your presentation designs.
Presentation Tutorials	A search for "tutorial" and "PowerPoint" or the software application you are using will provide countless results. Narrowing the topic further by adding a keyword such as "transitions" will provide more specific results.

Create an original six to ten slide presentation. Your goal is to communicate an instructional message to specific grade level. The topic is open ended. Use the checklist in Appendix 2. to assist in the planning process. After you have completed your presentation evaluate it using the rubric provided in Appendix 2.

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McLuhan, M. (1964) *Understanding media: The extensions of man*. New York, McGraw Hill.

Anderson, D. R., Huston, A. C., Schmitt, K., Linebarger, D. L., & Wright, J. C. (2001). Early childhood television viewing and adolescent behavior: The recontact study. *Mono graphs for the Society forResearch in Child Develop ment*, 66 (Serial No. 264).

Wiggins G., & McTighe, J. (2005). *Understanding by design*. 2nd Ed. Alexandria, VA, Association for Supervision and Cur riculum Development.

Chapter 2

Instructional Graphics

Using Imagery to simplify complex information

Students learn in many ways, so it is important for teachers to consider various modes of learning when preparing instruction. The linguistic mode of learning involves the written and spoken word. This mode appears in instruction as reading, writing, and listening. In contrast, the non-linguistic mode of learning involves imagery, the senses, and kinesthetic activities. Maps, charts, graphs, diagrams and other forms of imagery are also commonly used in instruction. By combining photos, symbols, graphics, numbers, and words into visual forms, teachers use imagery to simplify complex information, thus making content easier for students to comprehend. Today, graphics are everywhere. They appear as bar and pie charts in newspapers, or as tables and graphs in television newscasts. Graphics also are found in books, magazines, the Internet, brochures, kiosks, and many other places.

The combination of images, numbers, and text create visual messages, which help students understand and remember information more easily and for longer periods of time than words alone. This is especially true for visual learners. For example, viewing a chronological list of historical events and dates provides less contextual information than viewing a timeline of historical events keyed to a map. Imagery captures attention quickly. In this chapter you will learn how to plan and use imagery in instruction and you will learn techniques for using technology to create instructional graphics.

What are instructional graphics?

Instructional graphics can be used with any subject and any age group. Unlike some of the instructional approaches presented in this textbook, instructional graphics do not involve a specific set of implementation steps. Instead, instructional graphics may be used within any instructional model, provided the graphic is consistent with a lesson's learning outcomes.

Before creating an instructional graphic, you should know the instructional content, the expected learning outcomes and the purpose your graphic serves. These pre-considerations influence how a graphic will be designed and structured.

Uses of Instructional graphics

Charts, graphs, concept maps, idea webs, timelines, posters, and diagrams, represent just a few of the many types of graphics appropriate for instruction. Determining the type of graphic to use in instruction can be difficult, since each type of graphic serves a slightly different purpose. Understanding how instructional graphics vary can help you to decide which form is best for a particular purpose. For example, a visual about zoo animals (See figure 1) can:

describe various animals
tabulate the life expectancy of different species
include exploration materials like a map with 'zoo' facts
Include stylized drawings of various animals

Before you use graphics in instruction, think about how to accurately portray data, simplify content, address learning outcomes, and engage the students in the lesson.

FIGURE 1

Zoo animals

Content and Learning Outcomes

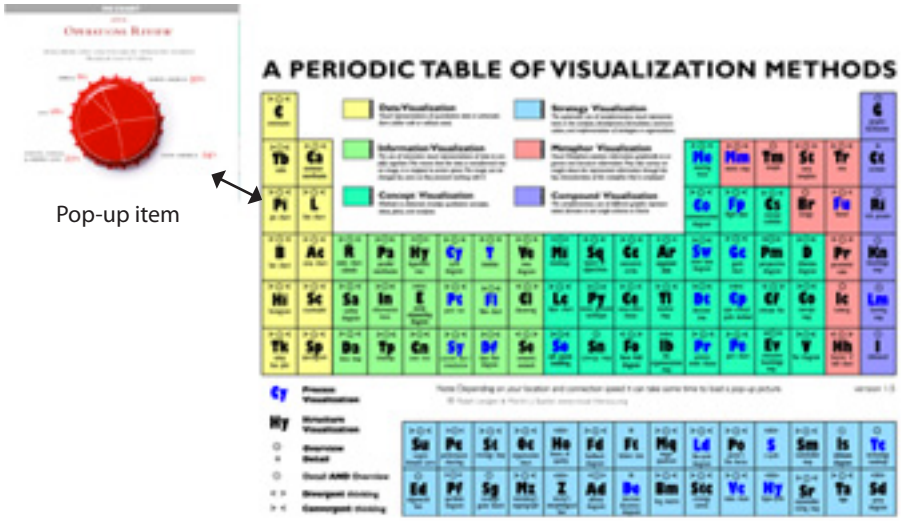
In addition to its purpose, the type of content and student learning outcomes influence the selection and design of instructional graphics. Lengler and Eppler (2007) created a graphic using the periodic table of the chemical elements to describe visualization methods. They grouped similar visualization methods together and organized them by color. (See figure 2). The methods are categorized by functions as in table 1.

TABLE 1
Categories of visualization methods

Category	Function	Example
Data visualization	For presenting an overview of data	Pie charts, area charts, bar charts, line graphs.
Information visualization	To discover relationships and to amplify acquisition or use of knowledge.	Timeline, flow chart, cycle diagram, tree maps
Concept visualization	To elaborate concepts, ideas, plans, and procedures.	Concept map, decision tree, cause-effect chains
Metaphor visualization	To convey complex insights through the key characteristics of the metaphor that is employed	Metro map, bridge graph, story template.
Strategy visualization	To analyze, improve or achieve a specific goal	Strategy map, organization chart, performance chart
Compound visualization	Combination of graphic representation formats in one single frame	Cartoon, complex knowledge map, etc (see figure 1)

FIGURE 2

Periodic Table



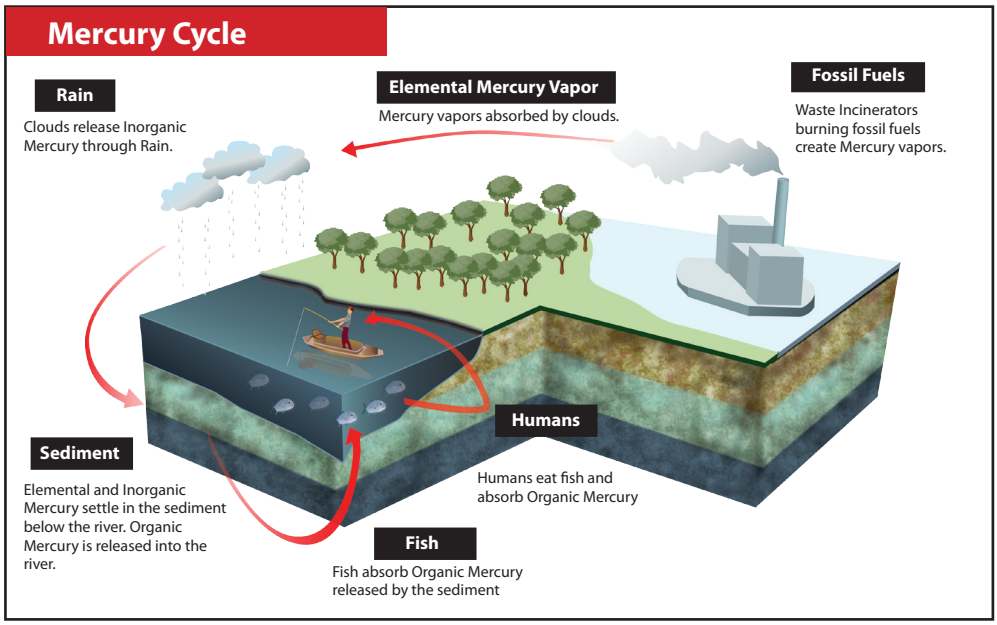
Periodic table of visualization methods from Lengler and Eppler (2007). (Image courtesy of Martin Eppler, http://www.visual-literacy.org/periodic_table/periodic_table.html)

What are the benefits of instructional graphics?

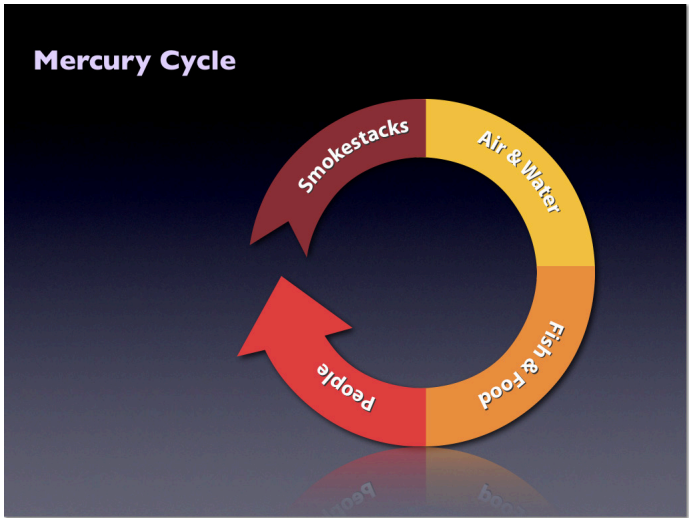
The old adage, 'a picture is worth a thousand words' points out how an image can tell a complex story in a simple, clear and understandable manner. Assuming the graphic does not degrade, distort or remove key data, a 'descriptive' form of an instructional graphic provides students with detailed information. Compare the two visuals in figure 3. The primary message is the same, but the level of detail is greater in the graphic depiction of the Mercury cycle. The more closely the viewer examines the visual, the more the explanatory details emerge. In contrast, the picture of the slide makes students more dependent on the teacher for the details supporting the primary idea.

FIGURE 3

Comparison of a Mercury Cycle instructional graphic and a presentation slide



Instructional graphic

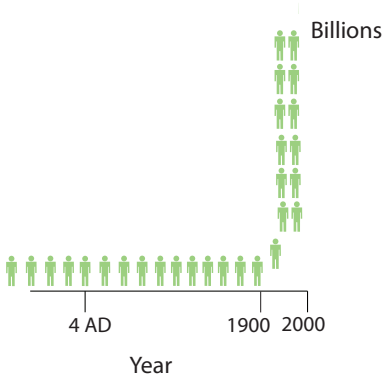


Presentation Slide

An instructional graphic may represent data in a manner that is easier for students to understand than a verbal explanation of the data. The graph in figure 4 represents data about human population growth in a simple and understandable manner.

FIGURE 4

Representing data

Human Population Narrative	Human Population Timeline
Throughout prerecorded history human population was below 10 million world wide. In the year 1900 the world population was one billion. 100 years later it is six billion	

One way you can help students better understand a graphic is to encourage them to explore or investigate the visual carefully. This exploration of the graphic may lead students to ask what, why, and how questions regarding the associated content. For example, with guidance, the alphabet in figure 5 can encourage students to explore sounds and words associated with letters.

FIGURE 5

Exploratory Graphics

Image courtesy of Katie Calhoon

Detail of Graphic

In summary, instructional graphics can provide key details that students need to help them understand the message. In addition, information presented visually may be more understandable for students who struggle with linguistic skills.

How to plan Instructional Graphics

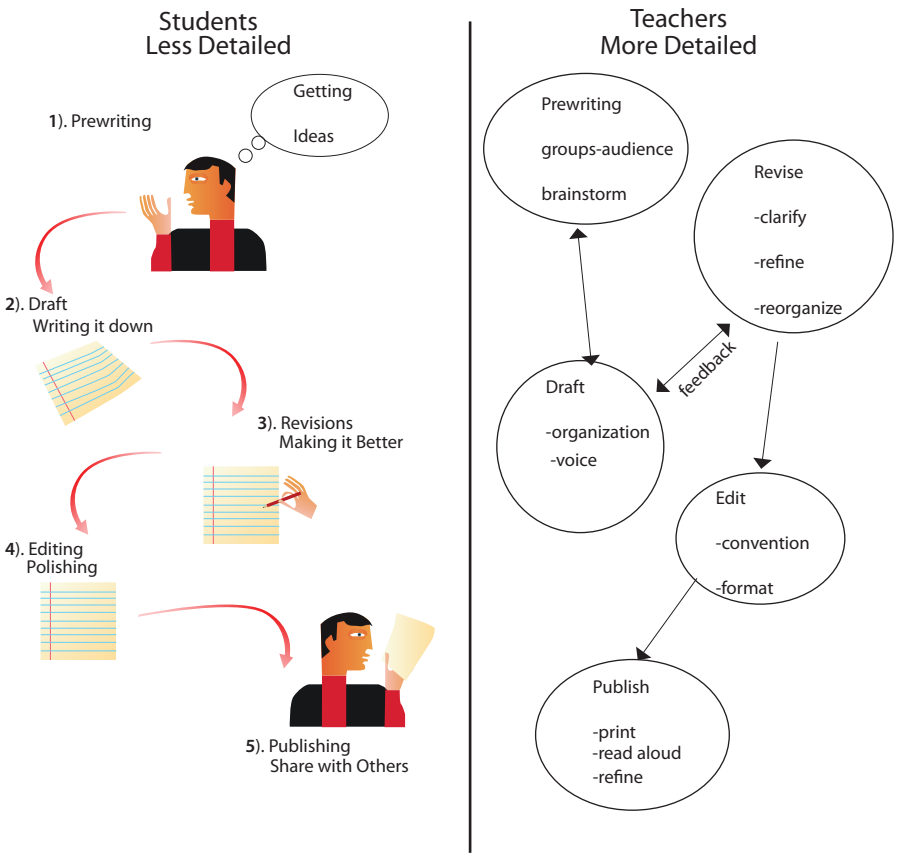
Many teachers avoid creating instructional graphics because they believe they lack artistic ability. This avoidance is understandable because we are bombarded with professional-looking graphics in print, computer and television media; however, you can produce quality graphics suitable for classroom use by following a systematic approach that takes purpose, design, and technique into account.

The goal of an instructional graphic is to capture the attention of students to communicate an idea. As such, many of the principles discussed in Chapter 2 on presentation techniques also apply to instructional graphics. Every instructional graphic should serve a clear purpose, so planning begins with the identification of the instructional goal(s). Is the goal to describe information to make it clearer? Is the goal to organize or tabulate information to make comparisons and explanations easier? Is the goal to provide an environment for exploration of new content? A good rule of thumb in planning an instructional graphic is to identify the goals and draft a story that the graphic is to convey before actually creating your graphic. In figure 3, the story in the instructional graphic revolves around human input into the mercury cycle. The slide version of the mercury cycle (figure 3) generalizes the cycle, diminishing the emphasis and impact of human inputs. Both examples are valid, but each addresses slightly different goals.

As with any form of instruction, knowing your students is critical. Decisions regarding the tone, language, choice of images, design, and layout will be based on the students and what you think will work best for them. For example, a visual that shows the steps of the writing process for middle school students would have a less formal tone, contain less detailed information, use more dynamic graphics and simpler language, than one designed for the professional development of English teachers. (See figure 6)

FIGURE 6

Knowing the Audience



In order to meet lesson objectives, effective instructional graphics need to focus on content pertinent to those objectives; otherwise students may become confused or overwhelmed by the visual details. Based on your students' needs, you may create an original graphic, revise an existing one, or search for a usable example from the Internet.

Graphic design is a complex endeavor, one that may take years of study in order to become proficient. However, if you follow basic guidelines for designing and developing graphics, you can produce effective instructional materials for classroom use. The guidelines in table 2 provide steps to follow when constructing instructional graphics. Given the wealth of materials available on the Internet, it pays to conduct a thorough search for fair use images before deciding to create original graphic(s).

TABLE 2
Guidelines for constructing instructional graphics

	Steps	Description
1	Purpose	Determine the type of instructional goals – description, tabulation, exploration, or a combination.
2	Content	Identify the type of content being presented and the expected learning outcomes. .
3	Audience	Identify the knowledge and skills the students already possess.
4	Rough Draft	Create a simple, small-scale pencil sketch. This draft may require revisions.
5	Collect Materials	Search for fair use content from the Internet or create original content. Note that you may find an acceptable instructional graphic during an Internet materials search, thus eliminating the need to create an original graphic.
6	Assemble graphic	Use your rough draft and collected materials to assemble the graphic. Verify that your purpose is being met and that you have followed basic design principles. (The Visual Literacy Tutorial web site listed in the Web Resources for this chapter provides an overview of basic design elements and principles)
7	Revision	Revise as needed.

How to implement Instructional Graphics

Instructional graphics may be implemented with any teaching approach. A simple, yet effective method for implementing an instructional graphic is to share the graphic with the intended audience by providing a print copy or by projecting the information in a manner that ensures key details are visible to the audience.

Many graphics can be used in multiple ways. For example, you may choose to use a graphic such as a timeline as an advance organizer for a lesson, or as a way to encourage students to analyze information, draw conclusions, and make predictions. As an advance organizer, (see chapter 4) the graphic is presented at the beginning of instruction. You state the overarching meaning of the graphic and tie it to the learning outcomes. You may then explain or describe the timeline events and ask students about these events to verify their understanding. In the advance organizer approach, the goal is to tell students what they need to know in order to help them make sense of the content. Using a different instructional approach, where your goal is to have students infer meaning from the timeline rather than explaining timeline events, you ask students to describe events, compare events, explain why one event followed another, or predict what might occur next.

Sometimes an instructional graphic is used to describe how-to do something or to provide step-by-step information. For example, a graphic may show how to mix a chemical solution. You can project the mixing steps on to a screen or interactive whiteboard, explain the steps, and demonstrate how to complete each step. Subsequently, the graphic is available to students to use as a guide when they mix a chemical solution.

Other implementations can involve the use of data organized into graphs, charts or tables. Again, you may choose to explain the information and then verify student understanding, or simply present the tabulated information to students and ask them to describe, compare, or explain the data as in a concept development lesson.

If you want students to carefully analyze a visual, make sure you give them time to explore the graphic and then ask them to describe and/or use the information embedded in the graphic. For example, you can share a graphic (See figure 1.), ask students for their interpretation of the contents, and then have students use the graphic as a springboard for a writing activity. Numerous options are available for the use of graphics and visuals. The key to using visuals is to ensure that they match the lesson goals.

A less common, but powerful way to use graphics is to have students create their own visuals. Using graphics in this way requires that students possess sufficient background knowledge in the content to produce an accurate presentation of the information and sufficient technology skills to create the graphic. Clear directions, expectations, and evaluation criteria are the minimal conditions necessary for students to create meaningful graphics. Providing students with clear guidelines and how-to steps is recommended, especially when students are using technology tools to create their graphics.

Collaborative group work is encouraged for student-designed graphics so students can refine how they depict the information through discussion, questioning, and revision. In addition to preparing students to think nonverbally, student-designed graphics require that they understand the information more fully. Even under the best circumstances, lessons including student-produced graphics will require additional time for development and revision.

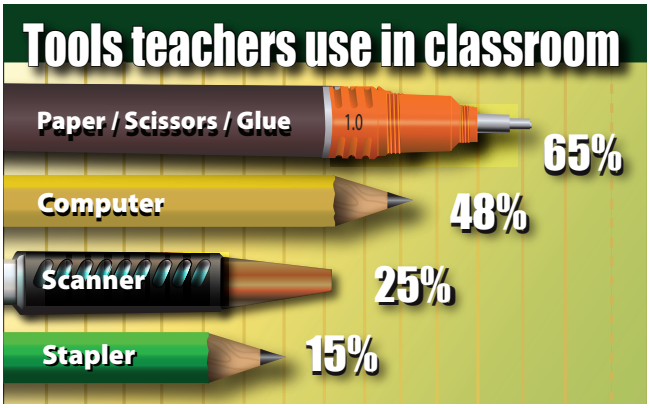
How to evaluate Instructional Graphics

Instructional graphics are not an instructional model so the evaluation of their application in instruction is tied directly to the learning outcomes of the lesson. A good graphic helps students understand and remember complex information better; however, a poor graphic may deliver inaccurate information, misdirect students' attention, or waste their time. If a graphic contributes to student acquisition of learning outcomes, then it may be considered effective. Although no step-by-step evaluation guidelines exist for the use of instructional graphics, Wileman's (1993) visual design considerations of clarity, unity, and imagination may be used as guidelines for the evaluation of technical aspects of graphics.

Clarity: Key points and the design of the graphic are clear, relevant, and comprehensible
Unity: Content and graphic are well laid out
Imagination: Graphic grabs the attention and interest of the viewers and is memorable

Graphics software and online images make it easy to add artistic flourishes to graphics. Teachers must be careful to avoid what Tufte (1983) calls "chart junk," which is the unnecessary addition of graphics that detract from the meaning of the content. Internet examples such as the Snapshot charts at USA Today sometimes include elements that detract from the meaning of a graphic (See figure 7). Notice how the text and the images do not correspond to each other.

FIGURE 7
Chart Junk



How Can Technology Support Instruction Using Visuals?

Many software programs can be used to create graphics. Graphic (drawing and painting) programs such as Photoshop, Corel Draw and Paint ShopPro are useful in designing instructional graphics. However, the learning curve of sophisticated graphics programs can be steep, and many of their features are beyond the needs of most teachers. Simple graphics programs, available from the Internet as downloadable freeware or shareware, or the drawing utilities packaged with word processor software may suffice for many instructional graphics. Spreadsheets are useful for creating charts and graphs. Specialized software such as Timeliner, Inspiration, and mathematics visualization software may also be used to create graphics. Media features such as animation, video, audio, and mouse over images may increase viewer understanding of graphics accessed on computers, but they may require time to learn.

Technology - How - to

A variety of programs may be used to create graphics. Check the software applications available on your computer. Even a common application such as Microsoft Word provides tools to develop effective graphics for instruction. In this section, MS Word is used to create an instructional graphic. Any software with basic drawing tools can be used to create this graphic.

For this how-to, you will make a graphic introducing elementary school students to the scientific method. Throughout the process seek feedback from colleagues to ensure your graphic makes sense.

Step 1: Purpose—Indicate the instructional goals: description, tabulation, exploration, or a combination.

The scientific method includes several procedures and the relationships among them. The goal is to describe each step and clearly identify the relationship from one step to another.

Step 2: Content—Identify the type of content being presented and expected learning outcomes.

The content you want to deliver is the general steps of the scientific method. Potential visual types for the steps include timelines, flowcharts, concept maps, and cause-effect chains; a flowchart will be used to visualize the general steps of the scientific method.

Step 3: Audience—Identify the knowledge and skills the students have.

Assume the audience is upper elementary students. Easy-to-understand terms for the scientific methods with interesting graphics or clipart may capture their attention and clarify the steps.

Step 4: Rough draft—Create a simple, small-scale pencil sketch.

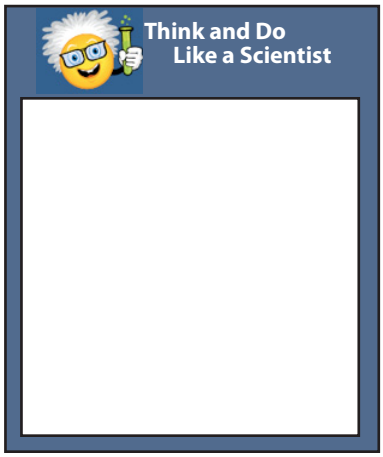
Make a rough draft or your flowchart on a piece of paper to help visualize how the finished product may look.

Step 5: Collect materials—Search for fair use content from the Internet or create original content.

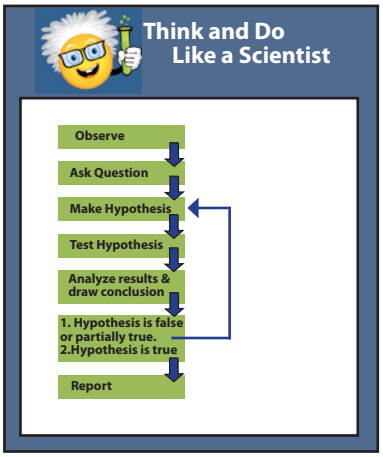
Be sure to follow fair use guidelines for any materials found on the Internet. In addition, record the sources of collected materials. If you are creating your own graphic, sketch your ideas on paper.

Step 6: Assemble graphic —Use the rough draft and collected materials to assemble the visual.

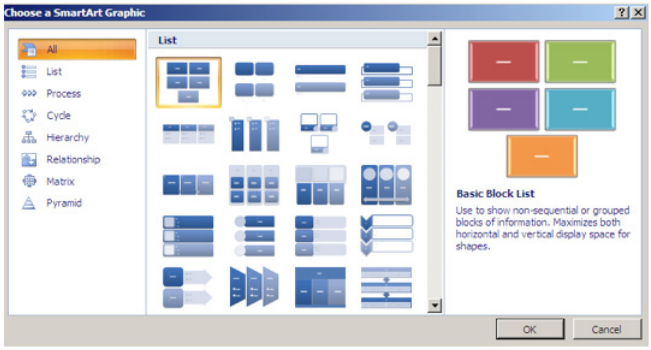
Begin by adding a background color, title, clipart, and a textbox. Methods which facilitate layout and placement are the use of text wrapping around the clipart or image, and using text boxes for the title.



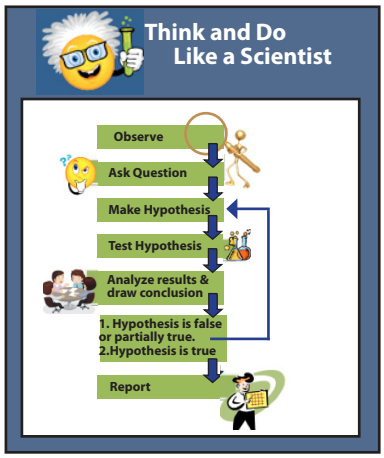
Continue using textboxes, shapes, arrows, and lines to present the scientific method.



The SmartArt library in MS Word contains many premade, professional looking charts for presenting processes, such as the cycle, hierarchy, and pyramid. Additional clipart examples for visual organizational schemes are available on the Internet.



Finally, add clip art relevant to the terms of the graphic and which are appropriate for the target audience.



Step 7: Revision—Revise as needed.

Be sure that the concept addressed is clear and that words and images used in the visual are appropriate for the intended viewers. Step back and take a fresh look at your visual to ensure the overall design is pleasing. Ask for feedback from colleagues on your best drafts and redo if necessary.

Web Resources for Instructional Graphics

The Internet has reduced the need to create many graphics, but the examples available online may not fit your students' level of understanding and may need revising to be effective. Conducting an Internet search for appropriate graphics can save you time in design. Also, fair use images may be incorporated into the graphics you create for classroom use. Listed below are some common sources for creating instructional graphics.

Visual literacy tutorial
http://www.ehhs.kent.edu/community/VLO

Timeliners
http://www.tomsnyder.com/timelinerxe/

Inspiration/Kidspiration
http://www.inspiration.com/

Mathematics
http://www.wolfram.com/products/mathematica/index.html

Graphic Organizers
http://www.eduplace.com/graphicorganizer/

Adobe Photoshop
http://www.adobe.com/products/photoshop/family/?promoid=BPDEK

Adobe FreeHand
http://www.adobe.com/products/freehand/

Adobe Illustrator
http://www.adobe.com/products/illustrator/

Suggested Activities

Choose a topic related to your teaching subject area and grade level. Create an instructional graphic for one of the following purposes to supplement your instruction: description, tabulation, or exploration. Follow the six steps listed in table 2 to guide your planning and development of the graphic. After you have completed your instructional graphic, evaluate it using the rubric provided in Appendix 3

References

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The Diagram Group. (1980). *Comparisons*. New York: St. Martin's Press.

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Chapter 3

Direct Instruction

Teacher Directed Demonstration followed by Practice

direct instruction is a familiar teaching method. In its simplest form, direct instruction is teacher-directed demonstration followed by practice. There are many useful applications of technology in direct instruction. Presentation software, digital video, projection devices, and interactive are common to the demonstration step of direct instruction. Computer managed tutorials, and drill and practice software are common during the practice and feedback steps of direct instruction. In addition, the Internet offers many sites to help students memorize information, practice skills, or watch presentations. This chapter describes the direct instruction model and provides simple ideas for integrating technology into direct instruction lessons.

What is Direct Instruction?

Direct Instruction is a systematic teaching method supported by research and based on a long history of implementation and use in K-12 settings. The basic premise of direct instruction is that instructional tasks may be broken down into component parts, and the parts may be learned and reinforced through repetition. It generally applies to learning specific skills and uses prescribed instructional practices.

Any content that is structured and has clear guidelines for acceptable performance fits with direct instruction. As such, identifying content that benefits from repetitive practice, such as motor skills, or tasks that involve following steps, such as addition or subtraction, represent reasonable candidates for direct instruction. Teachers employ direct instruction with many of the content-based facts, information, and skills objectives common to PreK-12 curriculum.

Many variations of direct instruction exist, each with its own emphasis and adherents. However, presentation, guided practice, and independent practice are common features of all variations of direct instruction. This text follows Rosenshine's model (as cited in Joyce & Weil, 1996) of direct instruction. (see Table 1.)

TABLE 1
The Rosenshine direct instruction model

	Steps
1	Review previous material
2	State the objectives of the lesson
3	Present new materials
4	Provide guided practice.
5	Provide independent practice
6	Provide periodic review

What are the benefits of Direct Instruction?

Direct instruction focuses on discrete knowledge and skills. These forms of content suggest measurable and observable outcomes, making learning objectives in direct instruction easy to identify and evaluate. (see Appendix 1 – Learning Outcomes) Direct instruction is considered to be time efficient because it typically employs teacher-directed lessons in group-based instructional settings. The primary argument against direct instruction is that when applied incorrectly, the method can lead to rote learning. Another argument against direct instruction is that it is sometimes employed with content ill suited to component instruction. For example, one may use direct instruction to teach syntax and grammar, but this knowledge may not transfer to writing an essay.

How to plan for Direct Instruction

Your first step when planning a direct instruction lesson, is to verify that the content fits into at least one of these categories: factual information; procedural skills; or motor skills. If the content fits, then determine what students already know about the content. Identifying what students know helps you to determine what content students need to review prior to instruction. Once the content is identified, the topic of the lesson is broken down into component parts and a sequence of instructions, based on the six steps of the direct instruction model, are organized for each part. (see Table 1.) Planning includes preparing materials for review, identifying the objectives of the lesson, determining the presentation method and the amount of content, preparing practice activities, and determining evaluation criteria.

How do you know if the content fits a direct instruction model? You verify that the content represents one or more of the following types of learning – information (factual) motor skills, or procedural (step-by-step) skills. For example, consider teaching students how to use the basic graphic tools in a software package such as MS Office. The graphic "Line" tool represents one sub-skill of the graphic tools. To use the Line Tool, a student needs to:
recognize the icon of the Line Tool – information,
know how to use the mouse to select it – motor skill, and
follow a sequence of steps to place a line on the screen – procedural skill.

In this example, teaching how to use the Line Tool fits multiple criteria for direct instruction. Most graphics' tools involve the use of information, motor, and procedural skills,so direct instruction this example is appropriate.

How do you know what content to prepare for the review step? The decision on what to review is based on the prior knowledge and competence of the students. In the graphic tools example, if you are working with students who are familiar with computers, then minimal review of basic mouse or computer operations is planned. However, if students have limited computer experience, then you need to prepare instruction or review materials for basic computer skills before demonstrating how to use the line tool.

How do you prepare the learning objectives? Objectives are typically written in student-centered terms using the phrase "the student will be able to…" The outcome should be measurable and performance criteria should be included. In the Line Tool example, a sample objective might be; "The student will be able to draw a horizontal, vertical or diagonal line in MS Word using the Line Tool." This objective is measurable and observable. Since no criteria are provided, the student should be able to complete the objective 100% of the time. Preparing the objective in advance of teaching the skill clarifies what needs to be taught and tells students what they need to do to meet the objective. (see Appendix 1 – Learning Outcomes)

How do you plan presentation materials? Presentations will vary based on the type of learning (information, procedural, or motor skill) and the specific lesson objectives. However, presentations should follow a logical sequence derived from the analysis of the learning task being taught. In the Line Tool example, a presentation demonstrating each step of drawing a line will suffice for most audiences. Because repetition is a key aspect of direct instruction, consider drawing a line multiple times during the demonstration.

How do you plan guided practice? During the presentation step, outline the steps students need to follow to complete a task. Guided practice should mirror the presentation steps. In the Line Tool example, based on the students' prior experience, decide whether to have students individually demonstrate their ability to perform the task, or circulate around the classroom observing students practicing the task

How do you know when students are ready for independent practice? Teachers know students are ready to practice independently when they can complete a task correctly 85% of the time (Rosenshine, as cited in Joyce & Weil, 1996). This level of mastery is necessary to ensure that students are practicing a task correctly. Planning and creating the independent practice materials for the Line Tool example involves step-by-step directions for students to follow until they no longer need assistance to correctly complete the task.

Knowledge and skills diminish over time without practice, therefore you need to plan and create review materials that students complete as follow-

up to reinforce skills. For the Line Tools skills, consider including a series of refresher exercises prior to the introduction of additional graphics tools.

How to implement Direct Instruction?

Review

A direct instruction lesson begins with review. The review may be as straightforward as asking a few questions or it may require a detailed practice session. The length and focus of the review is dependent on the lesson objectives and how important the review items are for skill acquisition. Content review web sites exist for many learning objectives in the K-12 curriculum. For example, an Internet search for "elementary math skill review" results in an extensive listing of sites where students may practice previously learned math skills.

State Objectives

Rosenshine, (as cited in Joyce & Weil, 1996) recommends that students be informed of the objectives of the lesson. You can present objectives verbally or in written form. The approach employed is dependent on the content and the audience.

Present New Material

Presentation varies with the type of content being taught. Lecture, advance organizers, and demonstration are common methods to present new material using direct instruction. Regardless of the method selected, an organized and a thoughtful sequence of presentation is essential to student learning. Projection devices and interactive whiteboards are common technologies employed in the presentation step of direct instruction.

During modeling, the teacher demonstrates the skill to be taught and the student imitates the skill. The teacher may demonstrate a skill such as how to produce a brushstroke with watercolor paint, how to pronounce a word in a

foreign language, or how to set up a geometric proof. In each example, the teacher demonstrates an accepted method for the student to imitate.

During shaping, the teacher may take the modeled task and separate it into component steps. In the brushstroke example, shaping may include first demonstrating and practicing how to hold the paintbrush, how to dab the brush into the paint, and how to apply the brush to the canvas. In the language example, shaping may involve practicing the enunciation of individual syllables, then combining the syllables into words. In these two examples the teacher works toward "successive approximation" – building the skill up from its component parts until the whole is mastered.

Throughout the instructional process, the teacher shapes student behavior through feedback and reinforcement. Feedback, both positive and corrective, helps students to monitor their progress. Positive feedback provides reinforcement when a task is performed correctly. Feedback can be intermittent. For example, a teacher may walk around the classroom and comment that someone is holding the brush correctly. Feedback can also be continuous. Consider an online mathematics tutorial, as a student works through a sequence of instruction, a computer can provide feedback for each step the student completes.

Negative feedback however, can be problematic if not combined with an explanation. Rosenshine (as cited in Joyce & Weil, 1996), uses the term corrective rather than negative feedback. Corrective feedback includes a description of the incorrect behavior and how to correct it, thus offering the student a reference for adjusting performance.

Guided Practice

Practice may begin once students understand the knowledge or skill presented in the lesson. Guided practice includes instructor assistance. Guided practice is usually is in the form of step-by-step assistance. For example, an entire class works on an example posted on the board with each step completed before advancing to the next step. Frequently instructors skip guided practice and jump to independent practice. Skipping guided practice is not recommended as students have not automated the steps to complete

the task successfully and they may practice the steps incorrectly. Repeating the steps incorrectly lead to misconceptions and the misconceptions must then be unlearned and learned correctly. Perhaps the adage "practice makes perfect" should be revised to "practice makes permanent."

Independent Practice

Practice should remain focused on the previously presented and practiced tasks. The degree of difficulty of the practice problems may be increased, but no new content should be added if you want to remain consistent with what works in direct instruction. Rosenshine (as cited in Joyce & Weil, 1996), suggests that students should not move to independent practice until they can complete examples at an 85% accuracy rate. By achieving an 85% level of mastery, the students are less likely to practice incorrectly.

Periodic Review

Knowledge and skills diminish if they are not reviewed. Requiring periodic review of the content will help students to maintain mastery of a skill or body of knowledge.

How to evaluate Direct Instruction

Evaluation in direct instruction is tied directly to the learning objectives stated at the beginning of the lesson. Assessments such as tests, quizzes and demonstrations are common and appropriate in direct instruction provided the assessments reflect the knowledge and skills identified in the lesson objectives. For example, in the Line Tool example, asking students to demonstrate how to draw a horizontal, vertical and diagonal line with the Line Tool is an appropriate evaluation. Having students create an original drawing is not an appropriate means of evaluation since the objective was not to create artwork, but rather to use the basic functions of the MS Word's Line Tool. Evaluation in direct instruction is focused and specific.

How can technology support direct instruction?

There are many technologies, which support the steps of direct instruction. Table 2. lists common examples.

TABLE 2
Technology supports for direct instruction

	Steps	Technology
1	Review	Drill & Practice Software Presentation Software Interactive Whiteboards Response Devices (clickers)
2	State Objective	Presentation Software
3	Present New Material	Presentation Software Interactive Whiteboards Concept Mapping Software Multimedia (audio, video, animation) Document Cameras Graphics Software (to create print materials)
4	Guided Practice	Presentation Software Interactive Whiteboards Response Devices (clickers) Drill & Practice Tutorials
5	Independent Practice	Presentation Software Response Devices (clickers) Drill & Practice Tutorials
6	Periodic Review	Drill & Practice Presentation Software Interactive Whiteboards Response Devices (clickers)

Technology - How - to

Activity 1

Presentation software discussed in chapter 2 as a means for introducing new content, may also be used for review purposes. A popular form of review in direct instruction is to provide questions in a Jeopardy game-like format. The question board is projected for the entire class and the students select individual questions. Response devices, wireless handheld technology that record student answers (see Figure 1), are a useful review mechanism because they record and tabulate student input thus providing a snapshot of how well students understand the content at that point in time.

FIGURE 1
Remote Response Device

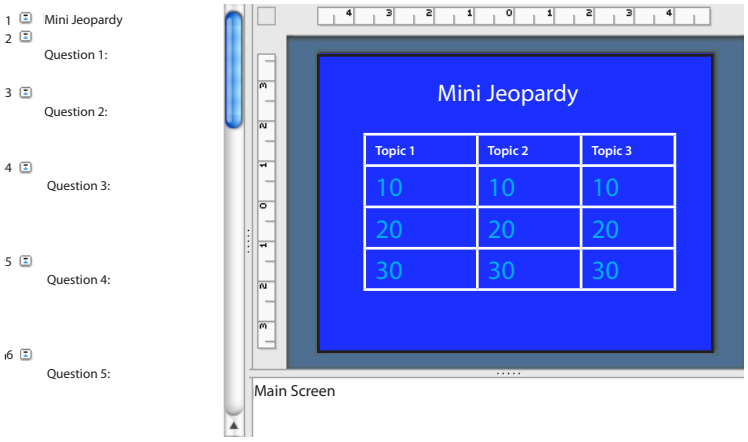
In this activity you will download a blank Jeopardy style presentation and add content to the Jeopardy style presentation. This game is designed for use with students for review and/or independent practice. The how-to directions are prepared for PowerPoint, but the principles apply across most presentation software.

Step 1

Download the template (mini-Jeopardy.ppt) file from the book website and open it in PowerPoint.

FIGURE 2

Title Slide



Step 2

Replace Topic 1, 2 & 3 with the following:

Topic 1 – Figurative Language
Topic 2 – Seasons
Topic 3 - History

Step 3

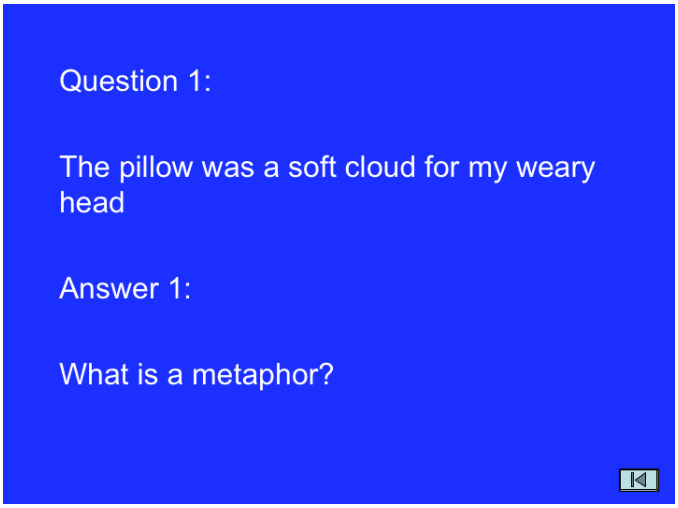
Replace the Topic 1 questions and answers.

Go to the Topic 1, Question 1 slide, and enter the following - The pillow was a soft cloud for my weary head.

Go to the Topic 1, Answer 1 slide, and enter the following – Question 1: The pillow was a soft cloud for my weary head.
Answer 1: What is a metaphor?

FIGURE 3

Question Slide



Go to the Topic 1, Question 2 slide, and enter the following – Her eyes were like the ocean, deep and clear.

Go to the Topic 1, Answer 2 slide, and enter the following – Question 2: Her eyes were like the ocean, deep and clear.
Answer 2: What is a simile?

Go to the Topic 1, Question 3 slide, and enter the following – I'm so hungry I could eat a horse!

Go to the Topic 1, Answer 3 slide, and enter the following – Question 3: I'm so hungry I could eat a horse!
Answer 3: What is hyperbole?

Step 4

Save your work and test the first topic.
Save your file to a location where you can find it, then go to the Slide Show menu and select View Show. Verify that the content was entered correctly. The lower left arrow takes you to the answer, the lower right arrow takes you to the main Jeopardy screen.

Step 5

Add remaining questions and answers, save your work and test the game.

Topic - Seasons

Question: The month of the Winter Solstice.
Answer: What is DECEMBER?

Question: The number of months in a season.
Answer: What is THREE MONTHS?

Question: The full moon that occurs nearest the time of the autumnal equinox.
Answer: What is the HARVEST MOON?

Topic - History

Question: FDR was a member of this political party.
Answer: What is the DEMOCRATIC Party?

Question: This agency was created in response to the stock market crash and was intended to prevent fraud.
Answer: What is the SECURITIES AND EXCHANGE COMMIS SION?

Question: The American government did this to pay for New Deal programs.
Answer: What is DEFICIT SPENDING?

Numerous Jeopardy style templates are available on the Internet. A search for "Jeopardy PPT template" lists many usable examples. Some are set up with slides for questions only, others include slides for questions and answers.

Activity 2

A major aspect of direct instruction is repetition usually in the form of guided practice. The Internet is an inexpensive source for tutorials and practice sites that emphasize repetition. Like all Internet searches, it takes time for you to review the search results to determine if a site is appropriate to your lesson goals. Also, many sites describe themselves as tutorials when they are actually drill and practice sites, so you should always thoroughly review a site before your students use it. In this how-to activity you will search for a practice site on the names of the fifty states.

Step 1

Practice sites

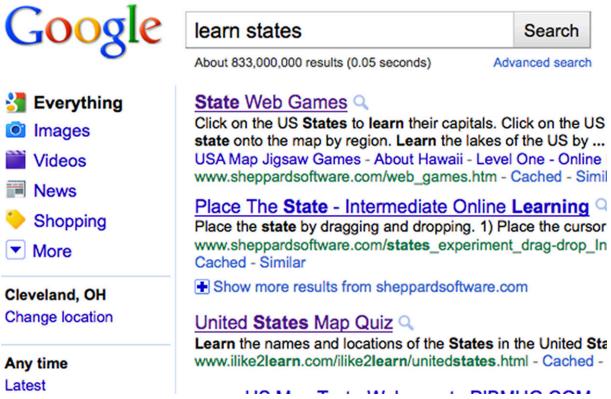
Open a browser window and go to a search engine such as Google, Bing or Yahoo. Enter "Learn States" as your keywords and click on Search. A list of sites related to learning the U.S. states will appear

Step 2

Selecting a site

Check out several of the listed sites. Each site takes a different approach to practice.

FIGURE 4
Google Search



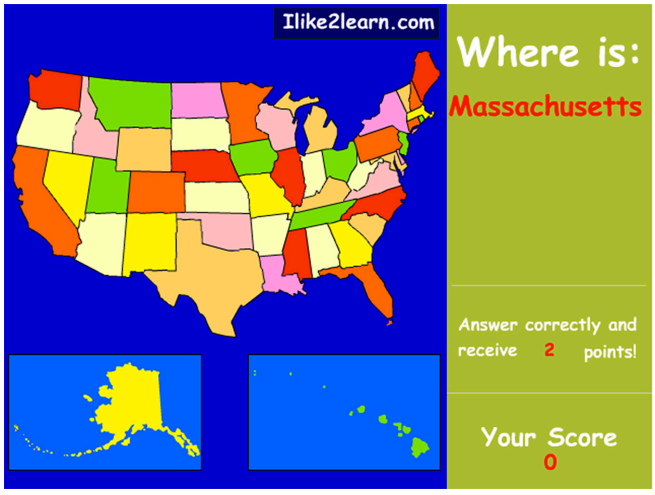
Step 3

Preview the U. S. Map Quiz at ilike2learn.com.

Go to http://www.ilike2learn.com/ilike2learn/unitedstates.html Because this example does not include initial instructions, it is appropriate for students who are ready for review or who are at the independent practice level. However, it can lead to random guessing by unprepared students

FIGURE 5

Ilike2learn U.S. Map Quiz



Step 4

Preview the states tutorial at the sheppardsoftware.com site.

Go to http://www.sheppardsoftware.com/web_games.htm and select the States tutorial. Clicking on a state provides the state's name. This game-like example is appropriate for students who need to learn the names of the states, since the state name is identified for the student. The game provides guided practice.

FIGURE 6
Sheppardsoftware
States Tutorial

http://www.sheppardsoftware.com/web_games.htm

Web Resources for Direct Instruction

Many of the teacher developed lessons on the Internet are direct instruction lessons. Internet Searches using keywords "lessons" and your content area will provide numerous results. A quick inspection of the lesson will inform you if it fits the direct instruction model. Other sites such as Slideshare and Google Docs provide tools for the presentation step of direct instruction. In addition, countless tutorial and drill and practice sites are available online. However, be mindful about the quality of these online materials; it can range from excellent to poor. As such, it is important to thoroughly review each site before sharing it with students.

Suggested Activities

Activity 1

Choose a topic related to your expected teaching area and grade level. Next, describe a direct instruction lesson that follows the first five of Rosenshine's steps (see table ….) ; review, state objectives, present new materials, guided practice, and independent practice. Explain how technology might be integrated into the lesson to improve the effectiveness of one or more of these steps.

Activity 2

Conduct several searches for tutorial and/or drill and practice sites that may supplement a lesson on a specific topic. Ask yourself whether a site emphasizes teaching new content or guided practice, or whether the site is geared toward review or independent practice.

References

Joyce, B. & Weil, M. (1996). *Models of teaching*. (5th Ed.). Boston, MA: Allyn and Bacon.

Chapter 4

Advance Organizer

A Map For Learning

an advance organizer is like a map in a shopping mall. Just as the mall map takes into account where you are in relation to the stores ("you are here") and provides a route to find any store, an advance organizer identifies where you are in relation to new content and provides an organizational structure to help you learn the content. Advance organizers have a long history. Since the beginnings of formal education, teachers have used what students already knew about a topic to teach them new information. In the 1960s, David Ausubel (1960) coined the phrase "advance organizer" to describe an instructional technique designed to connect new information with students' prior knowledge.

Presented at the outset of a lesson, an advance organizer involves a combination of a teacher telling, a teacher questioning and students answering. The straightforwardness of the instructional technique may be confusing to pre-service candidates since the name advance organizer seems to suggest something more sophisticated. In fact, many teachers have implemented advance organizers as part of their everyday teaching without knowing the technique is called an advance organizer.

Technology and the Internet provide tools and resources for the creation and delivery of advance organizers. However, whether one uses technology or not, the goal of advance organizers remains the same; to help students connect what they already know to new content. There are several different types of advance organizers. This chapter emphasizes how to use technology to create graphic advance organizers.

What is the Advance Organizer Approach

The underlying principle of the advance organizer is to connect new information with students' prior knowledge, thus providing a context for future understanding. The teacher explains how the content is interrelated and then verifies that the students understand the newly presented content. Research (Ausubel, 1960) suggests that content related to concepts, generalizations, and organized factual information is appropriate for advance organizers.

Creating an advance organizer can be time consuming. You need a solid understanding of the content and you need to determine what students already know about the content. Once the background knowledge of the students is identified, you organize the information so that connections between student's prior knowledge and new content are clear. This organization may take the form of a narrative, an analogy, or a visual depiction such as a concept map, timeline, or chart. After you have created the advance organizer, you share it with the students at the outset of instruction.

Since the advance organizer model is teacher directed, you tell the students explicitly what is important in the content, including the overall meaning and the meaning of individual components.

Instruction with advance organizers goes beyond "telling" since you also question the students on topics within the advance organizer to ensure that their understanding of the content is consistent with the actual meaning. Once students have a basic understanding of how the content is connected, you may introduce additional content. For example, assume you wanted to teach a lesson to an audience of first year education students on the technology knowledge, pedagogical knowledge, content knowledge framework (TPACK); the concept that underlies the structure of this text. (See figure 1.) You may follow the six steps presented in table 1 to teach the lesson.

FIGURE 1

TPCAK Framework

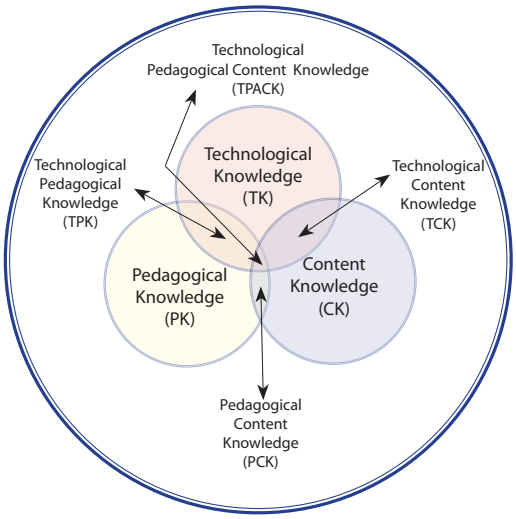


TABLE 1

Introducing TPACK

	Steps	TPACK Example for Undergraduates
1	**Determine what the students know**	First year education students have limited knowledge of TPACK. Most of the students will know that teachers have specific knowledge of their content areas. Also, many students have experienced different instructional approaches such as lecture, discussion, and group work, but they may not know that these instructional approaches are examples of pedagogical knowledge. Most students are familiar with how to use technologies. However, the students are less likely to know how to integrate technology into instruction. As such, an advance organizer will highlight basic information in the three areas of TPACK – technology knowledge, pedagogical knowledge and content knowledge, so students can identify the relationships between the three areas.
2	**Organize the information for presentation.**	The general message to convey about TPACK is that expert teachers use three distinct types of knowledge during instruction. One visual way to organize this information is in the form of a Venn diagram because it highlights the importance of the intersecting forms of knowledge. (See figure 1.) Consider creating a Venn diagram using graphic tools or searching online for an existing image to use as a graphic organizer for the TPACK concept. The choice of a Venn diagram to depict TPACK is not unique. The idea was pulled from the Internet, thus suggesting that not all advance organizers need to be original.

TABLE 1

Introducing TPAC

continued

	Steps	TPACK Example for Undergraduates
3	**Share the organizer at the outset of instruction.**	Share printed copies of the Venn diagram with the students, or project the graphic for all to see. Do this at the beginning of your instruction.
4	**Explain the important content in the organizer.**	Explain to students the meaning of the technological, pedagogical, and content knowledge circles, including detailed information about each type of knowledge as well as the overlapping sections. Use concrete examples to help the students understand how pedagogy, content, and technology knowledge are related. For example, you might describe how the writing process (a pedagogy) is effective in teaching students how to word process (technology) a historical (content) report.
5	**Ask students about content in the organizer**	Ask students to explain, in their own words, what technological, pedagogical, and content knowledge is, and to provide examples. Once satisfied that the students understand the basic concepts and relationships among them, consider describing additional TPACK attributes and explain how the different types of knowledge are interrelated. Depending on the students, presenting the entire organizer could take as little as ten minutes or much longer.
6	**Add new content to organizer in future**	Each time you return to the graphic you may add upcoming topics to the Venn diagram, such as different types of technological tools or pedagogical techniques to expand the meaning for students and to reinforce the original concept

What are the benefits of Advance Organizers?

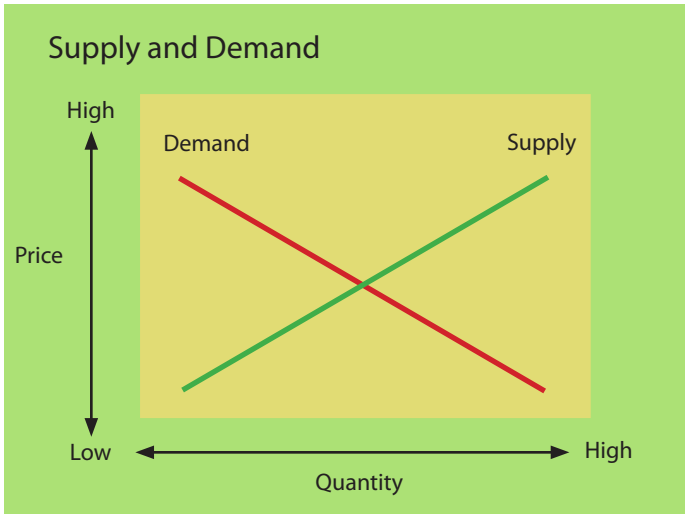
Advance organizers fit a familiar approach in teacher directed instruction, and they may be employed in a variety of instructional methods. Implementing an advance organizer can be time efficient for delivering instruction, since the information is provided directly to students. Advance organizers work well for group instruction in classroom settings, a setting common to K-12 instruction. Also, an advance organizer may be referred to throughout an instructional unit to provide reinforcement of the ideas embedded within it, as well as reminding students where they are and where they still need to go . Lastly, a practical benefit of advance organizers is that they can direct the acquisition of facts and information, a primary focus in most K-12 instruction.

How does one plan an Advance Organizer?

The first step in planning an advance organizer is to verify that the proposed content fits the criteria of concepts, generalizations or organized factual information. A lesson on the branches of government (information) fits the criteria, but a lesson on how to focus a microscope (motor skill) may not. If the content fits, then the next step is to ascertain what the students know about the content. Understanding what the students already know will help you select examples, which lead students to relate new content to their prior knowledge. The next step is to create an advance organizer as a graphic representation. For example, a generalization in economics is that price is a function of supply and demand (See figure 2). Numerous examples that graphically depict this relationship are available on the Internet.

FIGURE 2

Supply and Demand



In this example the broad idea "price" is organized around the quantity available (supply) and the demand . You can describe and differentiate each of these ideas to support student understanding. Having definitions and examples of the organizer content prepared in advance, will help you to lead students via questioning along pathways that will strengthen their understanding.

Keep in mind that concepts and generalizations usually contain exceptions. The process of resolving the exceptions among the ideas in the advance organizer is known as "integrative reconciliation" (Eggen, Kauchak & Harder, 1979). An awareness of exceptions will help you during implementation so you can explain to students why exceptions occur. Explanatory information about exceptions will also help students understand the bigger picture.

Overall, four steps to consider in planning an advance organizer are;

1. Identify the primary idea that will serve as the basis for the advance organizer.
2. Identify exceptions, similarities, and differences within the primary idea.
3. Identify ways to explain the exceptions, similarities, differences between the major components in the primary idea.
4. Determine if a graphic organizer is appropriate for the content.

Implementing an advance organizer is straightforward. First, the advance organizer is shared with the students at the beginning of a lesson dealing with new content. Consider projecting the advance organizer on an interactive white board, supplying a handout of the organizer to the students, or reading the organizer to the students.

Next, clarify specific terms within the advance organizer. Clarifying terms encourages students' understanding. Asking students to define in their own words the terms in an advance organizer is a practical way to ascertain whether students understand the basic idea(s). Assuming the students understand the basic idea, the next step is to identify any differences or exceptions among the key components. Providing students with examples, and asking them to come up with their own examples of the key components embedded in the advance organizer will help students differentiate among the components and provide you with further evidence of student understanding. Presenting less obvious examples or examples that contradict the primary idea, or asking students to explain problematic examples encourages students to reconcile what is different among the ideas that form the concept. For example, if the concept was mammals you might present the example of a duck billed platypus. The platypus lays eggs rather than bearing live young but it is mammal.

An advance organizer presentation may only take a small portion of instruction at the start of a new lesson, or it may require multiple sessions. The length of the lesson will be a function of the detail of the content presented in the advance organizer and the background knowledge of the students. It is unrealistic to assume that all students will grasp the information in an advance organizer the first time it is introduced. Returning to the advance organizer periodically during subsequent instruction will reinforce content connections.

How to evaluate the advance organizer

Evaluation of how well students understood the content in the advance organizer tends to be informal and formative. Informal evaluation may include asking students to rephrase content presented in the advance organizer or asking students to provide additional examples of the content presented in the organizer. For example, in the Supply and Demand scenario, ask a student to provide an example of price when the demand is high and supply is low. In other instances students may be asked to explain how examples within the organizer support the generalization or concept underlying the organizer. For example, "How does the lower price of winter coats in June support the generalization?" This type of evaluation is formative because it helps you to determine if the organizer was successful at organizing the information for students, and if students will need additional instruction on the content.

How technology can support instruction with advance organizers.

There are three common ways technology can assist in instruction with advance organizers. The first is in the design and creation of a graphic organizer, the second is the search and selection of advance organizers from the Internet, and the third is in the presentation of the advance organizer to students. The following software and hardware tools have proven useful in the planning and implementation of advance organizers. See Table 2.

TABLE 2

How technology can support instruction with advance organizers

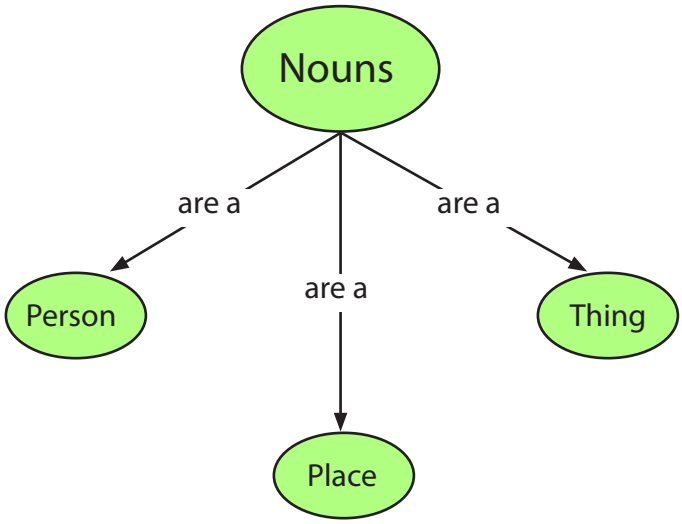
Use	Technology
Design	Word Processors, Graphics Software (including content focused graphics programs. Ex. Timeliner), Concept Mapping software such as Inspiration, Kidspiration or one of the many online concept mapping programs.
Search	Internet – finding existing graphic organizers
Presentation	Interactive white boards Projectors Presentation Software (Power Point) Large Format Printers - To create poster sized organizers for display in the classroom.

There are many forms of advance organizers which can be created with technology. In this section, the basic steps for creating a concept map, a graphic that may be used as an advance organizer, are described. A concept map is a practical and effective way to visually introduce new terms and relationships in many content areas. In a subsequent chapter we discuss student-created concept maps. Here, the focus is on teacher-created concept maps that are used as advance organizers.

Concept maps are typically made up of nodes and links. The nodes in concept maps are used to label key ideas and the links are used to connect the nodes and describe the relationships among nodes. (see figure 3.) When using a concept map as an advance organizer it is best to organize the map in a hierarchical manner with general topics above and components, details or examples on the next page.

FIGURE 3

Simple Concept Map

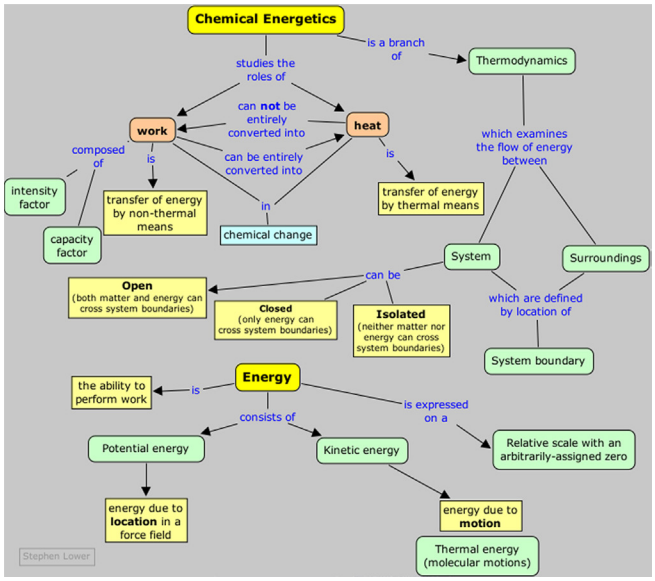


An Internet search for "free concept map software" provides list of concept mapping applications. Our recommendation is to learn the concept mapping software available at your school. If no software is currently in use, we recommend downloading several applications to determine which works best for your needs (see the Web Resources section for software providers.) Wikipedia also lists online concept mapping sites. Tutorials for how to use concept mapping software and online applications are available via the Internet. For example, a Google search for "Inspiration tutorial" provides multiple results for both downloadable and online Inspiration software tutorials.

Learning how to use concept mapping software requires basic computer skills. Learning how to design a meaningful concept map requires practice and revision when the advanced organizer doesn't work as you thought it would. Therefore, starting with well-understood content can help you create your design. For example, a topic such as energy (organized factual information) is an appropriate candidate for an advance organizer. However, this content is complex. (see figure 4.) http://www.chem1.com/acad/webtext/pre/pre-images/EnHeatMap.jpg

FIGURE 4

Energy Concept Map



Courtesy of the Chem1 Virtual Textbook by Stephen Lower. Image accessible at http://www.chem1.com/acad/webtext/virtualtextbook.html)

Sharing figure 4 at the outset of a lesson with students who have a basic understanding of energy concepts makes sense. However, the map might result in information overload if the students have little or know background in energy concepts. When working with students with limited background knowledge it is best to present manageable chunks of information, such as one concept at a time (see figure 5.) and then adding additional concepts incrementally as students develop an understanding. Although you may not present an entire concept map at the outset of a lesson, planning the complete map will ensure that the components you present incrementally are consistent across instruction.

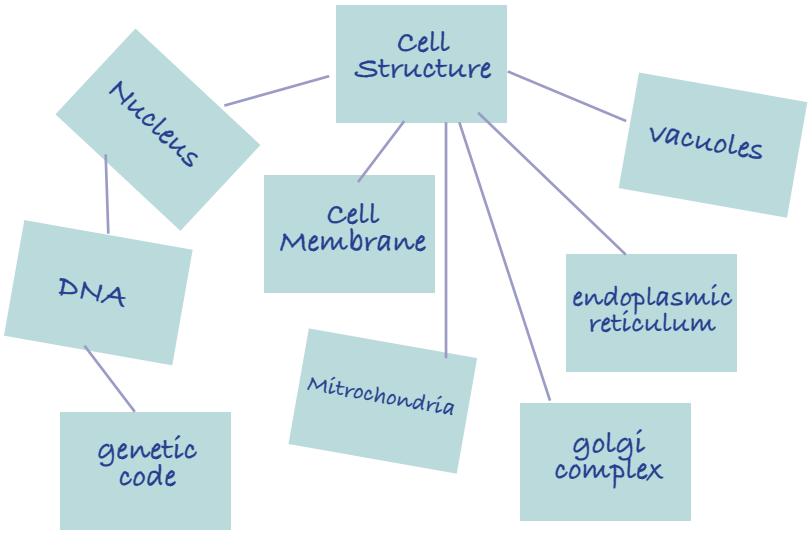
Creating a concept map

Step 1. Creating drafts of a concept map. The process begins with listing key ideas and supporting information. Consider identifying the following topics for an introductory lesson on cell structure: nucleus, cell membrane, Golgi Complex, Mitochondria, Endoplasmic Reticulum, Vacuoles, DNA, and Genetic Code. It is common to return to a course text or lecture notes to identify additional topics, as all topics may not be identified in the first pass.

Step 2. Organizing the topics and subtopics. The topics may be organized with post-it notes or via concept mapping software. The benefit of doing paper drafts is that you are less likely to become sidetracked with polishing the concept map's appearance. The initial topics mentioned above were organized into clusters based on relationships among the components. (figure 5.) For simplicity purposes, this sample concept map is shallow because only the nucleus node has any sub-topics below it.

FIGURE 5

Cell Structure



Step 3. Creating the Map. Convert the rough draft version to a computerized version. Software such as Inspiration or an online application such as bubbl.us may be used to create a digital version of your concept map. Revision is typically required to ensure that the organization of the content is complete and accurate. When first learning to create concept maps, begin with topics that are depicted with only a few nodes. Starting simple will give you the confidence to undertake more complex subjects later.

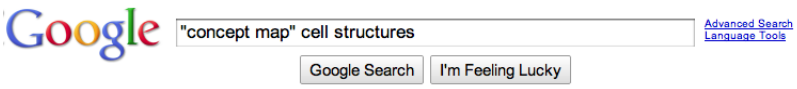
Use Inspiration or one of the online concept mapping programs such as bubbl.us to convert the draft version in Figure 5 to a digital version. It is suggested that you first complete a tutorial if you are not familiar with Inspiration or the online software you use.

Step 1. Selecting a search engine. There will be occasions when you do not have the time to create a custom concept map for a lesson. Fortunately, there are numerous examples available on the Web. Many of the examples fit within fair use guidelines so they may be used for classroom instruction. Finding usable examples requires an efficient search strategy. One way to expedite the search process is to use an image search engine such as Google Images or Yahoo Images. An image search will reduce the search results to graphic examples.

Step 2. Devising a search strategy. The goal of the search strategy is to find a concept map on a specific topic. Therefore, including "concept map" into the keywords will narrow the results to pages that include those terms. Coupling the "concept map" terms with topic delimiting terms, such as cell structures, will refine the search further. (see figure 6)

FIGURE 6

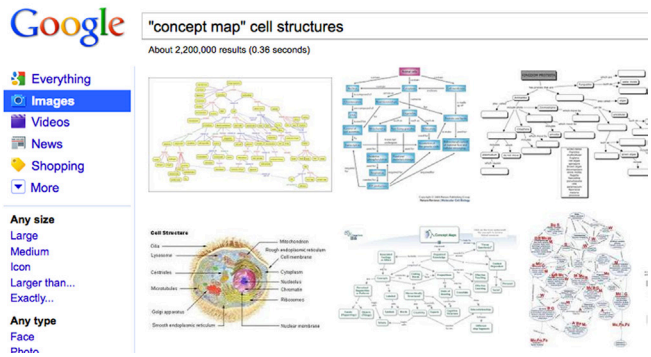
Search Strategy



Step 3. Selecting the concept map. The search query will list the results. Finding a map that works requires examining the thumbnail images. It may take several searches using different keywords before a usable concept map is found. (see figure 7.) In some instances, no maps will be usable.

FIGURE 7

Thumbnail Images

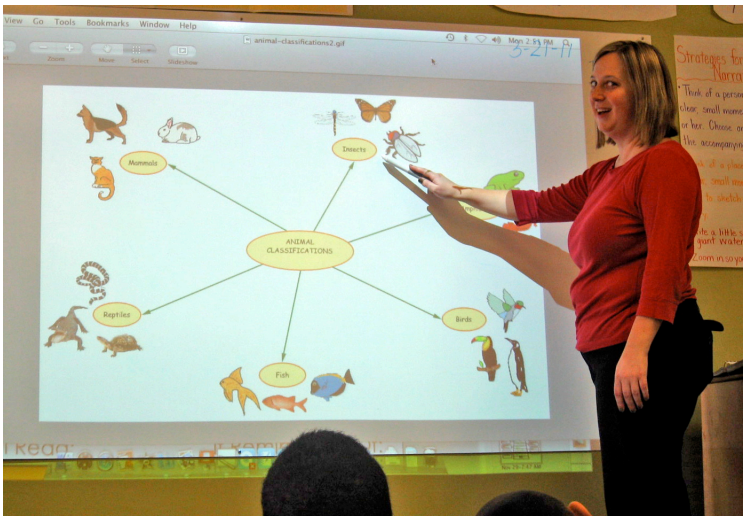


Step 4. Preparing the Concept Map. Once you have found a map with appropriate content, your next task is to decide if it needs to be revised for your audience, and if it is in a format that may be shared either through handouts or projection. The cell structures map in figure 8. was found on a University of California at Santa Cruz webpage. Consider sharing this Web site with the class, which eliminates the need to create an original concept map.

Presenting the concept map

Step 1. Projecting the concept map. From a technology standpoint, the primary requirements for projecting images are that the appropriate software is loaded on the computer and the labels on the concept map are large enough for students to read. It is best to test all equipment prior to the lesson. See Figure 9.

FIGURE 9
Projecting the Concept Map



Web Resources for Advance Organizers

There are many products available online with which you can create graphic organizers. Some are trial versions and require downloading the software. Others are fully online. Concept Mapping products used in schools include;
Inspiration, Kidspiration, Bubbl.us, SmartDraw, IHMC CMap, and Gliffy. Products for creating timelines include – Timeliner, xtimeline, timetoast, and timeglider. Graphic software applications and online products such as Kid's Zone Create a Graph, and even the table option in most word processors may be used to create graphic organizers.

Suggested Activities

Your task is to create a concept map that you can use as an advance organizer for a particular grade level, and specific content area. Completing these steps will help you create a concept map that can be used as an advance organizer.

1. Who is my audience?
2. What is my specific content topic?
3. Does my topic include interrelated facts and information?
4. List 7 to 10 facts related to the topic.
5. Write the facts on post-it notes or scrap paper.
6. Organize the facts hierarchically, relationally and/or categorically
7. Use the results from step 6 to create the map with software of your choosing.
8. Write a paragraph explaining how you would present the map to your audience. Include questions you would ask to assess student understanding.

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Mishra, P. (2010) *Punya Mishra's Web Home*. http://punya.educ.msu.edu/ Accessed at various times in 2009 and 2010.

Chapter 5

Data Collection and Analysis

Compare, Explain, Generalize, Predict

In many types of instruction, the teacher serves as the expert who provides answers and then explains how she obtained the answers. In a data collection and analysis lesson, you present data and then guide students to infer meaning from the assembled data. Unlike a teacher directed lesson, a data collection and analysis lesson teaches students how to compare, explain, generalize and predict; process skills that will help students make sense of the data they encounter, both in and out of school. This chapter describes concept development, a data collection and analysis methodology, and suggests practical technologies for planning and implementing data collection and analysis.

What is Concept Development?

Concept development is a model of instruction that engages students in data collection and analysis. Concept development encourages students to think inductively. Prior to a concept development lesson, the teacher identifies and prepares data sources and accompanying questions that the students will use to organize information, compare information, form generalizations, and make explanatory and predictive inferences (Gunter, Estes, & Schwab, 1995). Hilda Taba (1967), a proponent of inductive learning, believed students who engage in the processes of organizing data on the basis of similarities and differences, learn to think about how concepts are formed. As such, the concept development model addresses both the acquisition of content knowledge (product) and the learning skills (processes) required to attain the content

What are the benefits of the Concept Development approach?

Concept development teaches process skills that may be employed across all content areas. In addition, students retain concepts they derive better than concepts told to them. The primary disadvantage of concept development is that the model requires more time to implement than teacher directed instruction.

How does one plan a Concept Development Lesson?

The first step in planning a concept development lesson is to verify that your content fits the criteria of concepts, generalizations, or organized factual information. If the content fits, you collect data in the form of examples, activities, or information that support and define the concept or generalization under consideration. You then organize the data. A chart or matrix is a com-

mon approach for data organization. For example, let's assume you want your upper elementary students to recognize how the environment where Native Americans lived influenced how they lived. You might collect examples and organize them into a matrix to make the relationships evident. (see table 1) Note that the tribes and attributes selected keep the focus on the environmental influences. For this example, the attributes required an Internet search for the data. For simple examples such as a comparison between living and non-living things, the students can provide the data from their prior knowledge. In some instances the completed chart may be used solely for your planning purposes, but in instances where time is limited, a completed chart may serve as the starting point for student comparisons, explanations, generalizations, and predictions.

We recommend that initial attempts at concept development instruction include some form of data organization, like a table, matrix, concept map, graph, chart, or Venn diagram. Organizing the data helps to keep students focused on what is pertinent to the concept under development. The organized data can be projected or provided as a handout.

TABLE 1

Comparison of Native Americans

Native Americans	Location	Food Sources	Dwellings	Unique Tools	Clothing
Cherokee	Southeast U.S. Appalachians	Farming,hunting, fishing	Wood domed homes	Tomahawk, canoes	Deerskins and woven plants
Pueblo	Arid South-west-Colorado,Utah, Arizona,New Mexico	Farmers (desert irrigation), hunters	Multistoried stone and adobe homes	Grinding stones	Woven cotton and wool
Sioux	Plains-Central,North America	Hunters	Teepees (Tipi)	Buffalo hide products such as bags-parfleche	Buffalo skins
Chumash	Coastal California	Fishing,gathering (acorns)	Reed, grass and bark huts	Scagoing plank canoes, reed baskets	Animal skins, plant fiber(little or no clothing)

When conducting concept development lessons with students who are not familiar with the approach, use "garden path" data to facilitate understanding. Just like a path through a garden presents the plants in a set order. Garden path data provide a path through a topic to lead students to a specific conclusion. For example, the Sioux and Pueblo Native Americans were selected because their data make it easier for students to recognize the influence of food sources on dwellings. The nomadic Sioux lived in the easily moved Tipi, whereas the Pueblo had permanent structures to support year round farming. The data selected and organized for concept development is not limited to text or numeric information. Media such as photos, drawings, audio, etc can, and should be provided to students where appropriate. For example, many sites provide images of the data provided in the chart. Creating a text file of linked websites also known as a hotlist, or creating a webpage with links to supporting media are ways to make data come alive for students.

The Internet is a good source of data, but it is best to identify and review Internet data sources to ensure the data students encounter support the concept or generalization under consideration. Until students become confident in their ability to make sense of data, extraneous data and exceptional examples may confuse them. However, once a concept or generalization is understood, it is useful to present exceptions in the data.

How to Implement a Concept Development Activity?

In concept development, the goal is to have students make sense of data, but they are not likely to interpret data without being asked questions to help guide their thinking. From simple to complex concepts, from concrete to abstract concepts, your responsibility in concept development is to question students. As such, asking questions, even questions with obvious answers, will encourage students to make inferences.

Unlike the direct instruction model, the concept development model lacks a set of ordered steps. However, there are eight activities common in a concept development lesson, though they may not occur in every lesson and their order may vary. The following list from Eggen, Kauchak and Harder (1979), offers a range of process possibilities for concept development activities.

8 Activities
Listing
Grouping
Labeling
Data Collecting (organization of date -- the completed matrix is an example of this)
Explaining
Comparing
Generalizing
Predicting

How might you implement each process? Imagine a science lesson where the goal is to have students apply what they already learned about conduction, convection and radiation. Let's say you ask students to design a box capable of retaining as high a temperature as possible. At the outset of the lesson, provide the students with a set of construction materials. Next, you ask them to (1) list the items available for the box construction. Assume that the students list the following materials; plastic wrap, aluminum foil, newspaper, manila cardstock, cardboard, Styrofoam, and black construction paper. Next, ask them to (2) group the materials. Depending on the sophistication of your students, you may provide the criteria for grouping, or the students may devise their own criteria. Once the criteria and the groups are established, ask the students to (3) label the groups. Assume two labels are identified –conductors and insulators of heat. The data can now be (4) organized, collected, and placed into a matrix. The students need data for concept development.

Designing an experiment that controls key variables will make data collection more meaningful. For example, six equal size cubes, each one made of one type of construction material can undergo identical heat tests. A computer probe is placed into each cube to collect temperature data. Each cube is then placed under a lamp. The light is turned on for five minutes and turned off. (See Figure 1) From the time the light is turned on until five minutes after the light is turned off the computer probe records the temperature. (See Table 2)

TABLE 2

Identical Size Cubes Test Results

	Conductor	Insulator	Insulator	Insulator	Insulator	Insulator
Temperature Celsius	Aluminum	Plastic Wrap	Newspaper	Manila Cardstock	Cardboard	Styrofoam
Start-light on	22.9	24.21	23.0	22.9	23.9	22.7
At 5 minutes-light off	23.5	29.9	26.9	25.6	24.7	23.2
Max	23.52	29.9	26.97	25.63	25.0	23.36
At 10 minutes-End	23.0	25.1	25.5	24.6	24.7	23.1
Increase from start	0.62	5.96	3.97	2.73	1.10	0.66
% increase	1.03	1.24	1.17	1.12	1.05	1.03
Start/end difference	0.10	0.89	2.50	1.70	0.80	0.40

To ensure there is no confusion, ask students to (5) explain individual test results. Which box had the largest percentage increase? Why do you think the increase in temperature for the aluminum was so low and so forth? Once it is clear students can explain the data, seek (6) comparisons. Compare the results of the Newspaper to that of the Manila cardstock. Why are they similar? The point of the comparisons is to get students to identify similarities and differences, in other words to make sense of the data.

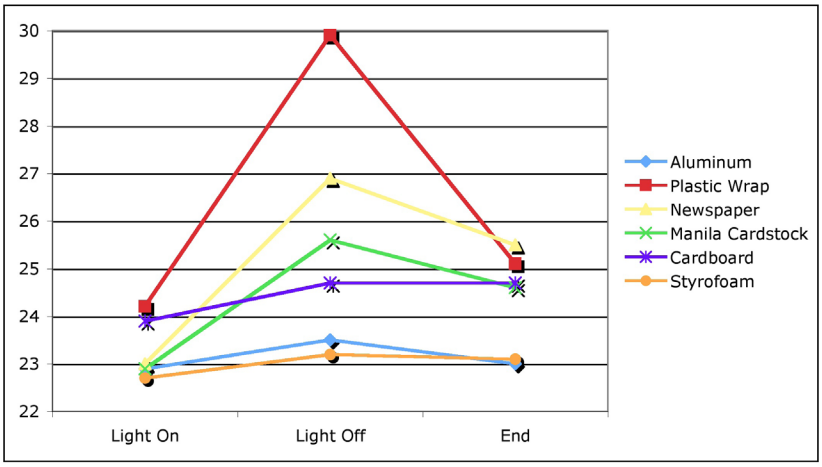
FIGURE 1

Heat Test Apparatus

Consider graphing the data and projecting it to make the relationships clear. (Figure 1) Next, ask students if they can generalize the results (7) What types of materials allow the greatest increase in internal temperature? What types of materials retain the temperature rise the best? Once the students establish a generalization about what materials are good for what purposes, pose the task of building a box from two or more materials that take advantage of the properties identified in the experiment. The students' selection of materials indicates if they can (8) predict which ones will perform the best. (See Figure 2)

FIGURE 2

Data Graph



The prior lesson is detailed. Simple versions of concept development can be implemented using only one or two of the steps. Simpler examples include; list all the desserts you like, classify the following rocks by type, compare the protagonist in three short stories, explain how three music scores are similar, and predict which countries are most likely to grow economically. The steps you employ are tied to your lesson goals. Including more steps implies a greater emphasis on instruction of process skills. Using fewer steps implies increased focus on specific aspects of the content.

How to evaluate concept development

Both content knowledge and learning skills are candidates for evaluation since both product and process are taught in the approach. Evaluating knowledge of the content may be accomplished by having students 1) describe a concept or generalization, or 2) provide examples of the content. Evaluating process skills is more difficult and time consuming. You may evaluate process skills by providing students with similar data and then asking them to derive a generalization, explanation, or prediction regarding the data. For example, in the temperature lesson consider asking students to predict what the graph of a box made from construction paper might look like and ask them to explain why.

How can technology support instruction of concept development?

The obvious technology is any software that creates matrices – such as the "Table" function in a word processor or any spreadsheet, but concept development is more than creating a matrix. Any technology that supports one or more of the eight identified processes is a candidate for use in concept development. (See Table 3)

TABLE 3

How technology can support instruction in concept development.

Processes	Technology
Listing	Word Processors Interactive White Boards
Grouping Labeling	Word Processors Concept Mapping Software Interactive White Boards
Data Collecting	Internet Scientific Probe Ware Spreadsheets Specialized Software – Geometric Supposer, Mathematica Databases (online and computer based) Simulation programs
Explaining, Comparing, Generalizing and Predicting	Interactive White Boards Graphing Software Presentation Software (Power Point) Simulation software

Technology - How - to

Step 1

Verify the content fits the lesson goals.

Living and non-living things are the content for the how-to example. The content fits because living and non-living things represent concepts defined by attributes.

Step 2

Determine the instructional goal.

The goal is to have students recognize that living things are characterized by the following; 1) made up of cells, 2) use energy, 3) grow, 4) reproduce, 5) respond to environment, and 6) adapt to environment.

Step 3

Collect examples

The attributes were identified in the instructional goals. What is needed next are examples that cover a range of possibilities. From the animal kingdom you might choose single cell animals like an amoeba, invertebrates like earthworms, snails, insects; vertebrates like fish, frogs, snakes, birds, rodents, and humans. For non-living you might choose natural and manmade objects such as rocks, clouds, water, cars, computers, robots, etc.

Step 4

Organize and Assemble Data

Six attributes were identified along with multiple examples of living and non-living things. Therefore, seven columns are needed for the attributes. To simplify the how-to activity only three living and three non-living examples will be charted. Additional examples may be required for a classroom implementation of the lesson, regardless of whether the data chart was provided for, or completed by the students.

Go to the "Table" option in your word processor and create a table with seven columns and seven rows. (See table 4)

TABLE 4

Blank table for organizing living and non-living things.

Add the attribute designations, examples, and responses to the table and then center the cells to improve readability. Note, several cells were left with a "?" since these responses may lead to student questions. (See table 5)

TABLE 5

Content attributes and likely responses.

	Made of Cells	Uses Energy	Grows	Reproduces	Responds to environment	Adapts to environment
Amoeba	Yes	Yes	Yes	Yes	Yes	Yes
Rock	?	No	No	No	No	No
Cloud	No	?	Yes	?	?	?
Frog	Yes	Yes	Yes	Yes	Yes	Yes
Snail	Yes	Yes	Yes	Yes	Yes	Yes
Robot	No	Yes	No	No	Some do	Some do

If your goal is to focus on the content, consider presenting a completed chart with several additional blank rows with other examples listed in the first column. If your goal is to emphasize process, begin with a blank slate. Ask students to list the attributes that distinguish living from non-living things. While they list their ideas, introduce examples to help them identify the six attributes you want them to isolate. As a class, consider constructing a chart using an interactive white board. Then ask students to generate examples and explain why they represent one category or the other. The form of your implementation will be dictated by the product or process emphasis found in the lesson, by the time available for the lesson, and by the sophistication of your students.

Web Resources for Concept Development

The Internet provides data sources across all content areas and grade levels. The more you know about the concept or generalization you want the students to learn, the easier it will be to find data that fits. Searching the Internet well in advance of lesson implementation will help you find data specific to your goals. Conducting a search for "classification lessons," "data analysis lessons," or "concept development lessons" may return useable results. However, it will take time to sort through the results to find lessons appropriate for your audience. A more efficient approach is to begin with a concept or generalization, and then conduct a search for data related to it. In both approaches you will still review numerous Internet sites before you find useful data.

Background information on the data collection and analysis instructional approach may be found by conducting searches with the following keywords, "inductive lessons," "Taba lessons," and "concept attainment lessons."

Additional sites for data analysis and concept development lessons include;

Lesson Planet, the Search Engine for Teachers.
http://www.lessonplanet.com/
Refining your search by grade level and using keywords such as "data analysis" will simplify your search on this site.

Create a Graph
http://nces.ed.gov/nceskids/graphing/classic/
Provides tools for graphing numerical data that your students have already collected.

Chartle
http://www.chartle.net/
Provides tools for creating charts.

Suggested Activities

Activity 1

If you have never participated in a concept development activity as a student, you should try the downloadable activity provided in Appendix 4. This activity requires that you view online versions of famous paintings, record your impressions, and compare attributes of the paintings to determine the key attributes of a style of painting.

Activity 2

Select a grade level and concept in any content area, and then search the Internet to identify resources you can use in a concept development lesson. To get started, follow the steps below:

List your grade level and content area

Identify a topic (concept, generalization or group of related facts) that lends itself to comparison within the content area you listed. Here are three examples

In social studies you can compare the reasons people emigrate to America by first identifying several immigrant groups, listing reasons they came to America, and exploring any overlap there was among the reasons they all came to America. This allows you to see if a generalization can be made.

In English language arts you can compare the works of two or more authors on the basis of character, theme, setting, and conflict to explain the differences in writing style.

In mathematics you can compare different charting and graphing methods to help students understand what type of data is presented (organized) best by each method.

Describe your idea

Identify two or more technologies you can employ in this "comparison" type concept development lesson and explain why you believe they may contribute to student learning.

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Eggen, P. D., Kauchak, D. P. & Harder, R. J. (1979). *Strategies for teachers*. Englewood Cliffs, N.J. Prentice-Hall, Inc.

Chapter 6

Inquiry

Generating & Testing Hypothesis

Inquiry is about students making explanations and although inquiry lessons vary, two processes appear consistently. First, students generate hypotheses – educated guesses to explain a problem, and second, students test their hypotheses to determine if they are valid.

How you conduct an inquiry lesson will depend on your content area, your lesson's goals, your grade level and the background of your students. For example, as a secondary biology teacher, you can direct your students to conduct experiments to test a hypothesis using agreed upon experimental techniques. As a middle school history teacher, you can present a historical problem and then engage students in research of original source materials to test whether one or more hypotheses are supported. As an elementary language arts teacher, consider holding up a book and based on the cover, ask students what they think the book will be about. Then ask them how they came to that conclusion and read the story to see if their conclusion was supported in the text.

Beyer's (1971) inquiry model was selected for this text because the instructional model is easy to follow and it generalizes well across content areas. It follows an approach where a specific problem is posed to students. Ideas for integrating technology into inquiry lessons are provided in the chapter, including a Webquest inspired technology "how-to".

What is Inquiry?

The goal of inquiry is to prepare students to seek explanations to problems. In the Beyer inquiry model, students develop hypotheses to explain a problem. They collect and analyze data to test their hypothesis and then draw conclusions. Unlike other instructional approaches that examine general topics, an inquiry lesson focuses on a specific problem that requires an explanation. For example, in a social studies inquiry lesson you can ask your students to explain why Lincoln was assassinated. This question works because the problem is specific and students must evaluate evidence to come up with a supported conclusion.

In order for inquiry to occur, the problem posed must match the students' level of understanding. For example, an elementary teacher asks students why some items float, while others sink. A middle school teacher asks why a character in a novel made a decision to act differently than other characters. A secondary social studies teacher asks students what caused oil prices to spike. The level of complexity increased in each of the examples and the content varied, but in each instance the students needed sufficient background knowledge to 1) venture an educated guess, 2) determine a method to test if the guess is accurate, 3) examine the evidence and 4) conclude if the guess is supported by the data.

When to use Inquiry

When considering whether to conduct an inquiry lesson, ask yourself, "Does this problem require an explanation?" A "yes" response to the question should lead to, "Is this problem within the abilities of my students?" Only when both answers are yes, should you consider using the inquiry approach.

Inquiry can be a difficult instructional approach for students to grasp because instead of you supplying the students with an answer, the students must develop the answer. Your role is to identify a problem that requires an explanation, organize the data sources or experiments, and to facilitate the process without giving the answer. In order for students to develop an answer they must possess the attitudes of curiosity and objectivity. Starting an inquiry with an interesting problem that also provides opportunities for explanations is a reasonable way to increase students' curiosity. Emphasizing the goal of testing hypotheses over identifying the "correct" solution will lead to greater student objectivity.

TABLE 1 Examples of process steps.

Step	Description	Example Language arts
Defining the problem	In order for inquiry to occur, students must first be aware a problem exists and that an explanation is within their ability.	A problem is defined and simplified to - Why did the author choose the setting of a reform school for his story?
Developing a tentative answer (hypothesizing)	A hypothesis is an educated guess. Students will examine the data, seek relationships and draw inferences. Your role is to probe students for ideas without providing an answer.	You list students' hypotheses on an interactive white board without judging the merit of the ideas.
Testing the tentative answer	Testing requires collecting and analyzing evidence. The techniques employed in testing vary across content areas.	You ask students to search for details in the story that support a hypothesis and/or details that refute a hypothesis.

TABLE 1
Examples of process steps. continued

Step	Description	Example Language arts
Developing a conclusion	Once relationships are identified in the analyzed data, the student is ready to state a conclusion. Was the hypothesis supported, not supported, or is more data needed to come to a conclusion?	Assume the students came to the conclusion that the setting was selected so the characters might overcome seemingly impossible odds. Have them list the details and write a paragraph summarizing their findings
Applying the conclusion	Provide students with the opportunity to see if their conclusion holds up against new evidence or if their explanation generalizes to similar problems	You might have your students read a comparable "overcoming the odds" story to see if the conclusion about the setting generalized beyond the original story.

What are the benefits of Inquiry?

Generating and Testing Hypotheses

Two benefits are frequently cited for instruction via inquiry. Inquiry teaches students process skills that are applied in real world settings, but that are seldom emphasized in school. Inquiry also teaches students to construct their own explanations to problems.

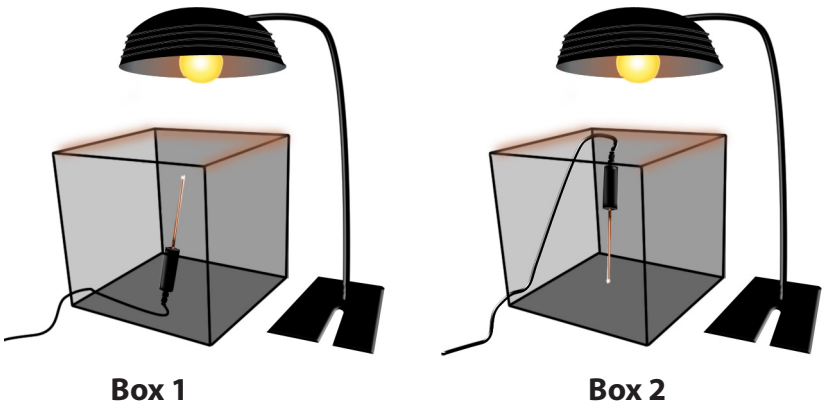
Disadvantages of inquiry include 1) it frequently requires access to original data sources, and 2) the approach is new to both students and teachers. Also, not all content lends itself to explanation by students. Some problems require

extensive prior knowledge in the content area to understand that a problem exists or that an explanation is necessary. Since Inquiry is an instructional approach that emphasizes process, it takes more time to conduct than teacher directed instructional approaches that emphasize product.

How does one plan for an Inquiry?

Inquiry is a difficult model to plan. One opportunity to plan an inquiry is when the content of the inquiry was taught previously via more traditional methods. The notion behind this type of inquiry is to see if students are able to apply the knowledge they previously learned to a specific problem. For example, in a science class on convection, elementary students may have learned that hot air rises and cool air sinks. On a test they should be able to identify the direction in which heated air moves. Knowing the answer is different from applying the answer. To see if the students can apply their knowledge of convection, present the students with two identical looking boxes. The inside of each box should contain a computer-based temperature probe. (See Figure 1.) Place the boxes under a lamp controlling for the variables of distance and light exposure. With the lamp turned on, the temperature data from the probes can be projected on a board in real time. The temperature with the probe collecting data from the top of the box 1 will rise faster than the box with the probe collecting data from the bottom of the box 2. Then ask the students why this occurred and how they might test their explanation.

FIGURE 1
Mystery boxes with temperature probes



Three steps were considered in the planning of the previous example;

1. A specific problem that requires an explanation was identified,
2. The problem was prepared by
   a) Identifying the kind of data or experiments need to solve it, and by
   b) Identifying possible hypotheses that the students might generate, and
3. A method of presentation to pique students' curiosity was determined.

The problem of explaining convection was identified and selected based on prior instruction. The students had sufficient prior knowledge regarding possible explanations to venture an educated guess about why the identical boxes gave conflicting results. The problem was prepared by creating identical looking boxes. Since the exteriors were identical, then any differences must be inside the boxes. How will you know what the students will hypothesize as the reason for the differences? One method is to ask a comparable audience. Another option is to record student hypotheses each time the activity is conducted and to add the student hypotheses to a list or database. It is important to know what the students may consider as a hypothesis because you need to have data or methods available for the students to use to test their hypotheses. In the temperature box example three hypotheses are common.

1. The boxes have different "stuff" inside.
2. One of the probes is not working correctly.
3. The temperature probes are not located in the same place in the box.

To address the students' hypothesis testing, you need to plan for data sources and experiments. For the different "stuff" hypothesis, you can show photos verifying that the insides of the boxes are identical. For the "malfunctioning probes" hypothesis, remove the probes from the boxes, test them in plain sight, and return them to the boxes. For the temperature probes are "positioned in different locations" hypothesis, ask the students to determine how to test this, which may mean running the experiment again with the orientation of the boxes changed. Since this inquiry is described as a group inquiry, ask each student to write down their hypothesis before any student volunteers a hypothesis.

If you began the lesson by asking the students which of two temperature probes – the one at the top or the one at the bottom of a box would show a rise in temperature first, most students should identify the correct answer based on their prior preparation. However, in an inquiry, part of the goal is to have the students engage in the process. Cueing students to the answer will not lead to inquiry. To get student attention without cueing them to the answer consider waiting until some time has passed between the time when the convection content was taught and when the inquiry activity is implemented. This time separation should reduce the likelihood of students basing their answer on the last thing they were taught.

You want to present the problem in a manner that is clear, yet interesting. By conducting the initial temperature test in front of the students, in real time, students see that the variables are controlled yet the results are different. The difference contradicts their expectation, so they are more likely to want to know why this difference occurs.

Planning for inquiry requires considerable work. Even the simple convection example involves creating test apparatus and experiments. In other instances, such as in social studies or language arts, planning requires identifying, accessing, and managing large quantities of data for student collection and testing. Even though identifying, preparing, and presenting the problem address basic inquiry planning needs, every inquiry lesson will have unique planning requirements.

Every inquiry begins with the presentation of the problem. An effective presentation causes students to wonder why. Presentations may include experiments, videos, reading an essay, telling a story, etc. The type of presentation is only limited by one's imagination and the nature of the problem requiring an explanation. However, in order for the inquiry to be successful, the presentation must focus on a specific problem that requires an explanation and that is within the students' level of understanding.

The developing a tentative hypothesis step of inquiry may involve something as simple as asking for guesses or it may require background research into the problem. The level of detail depends on the problem posed. Students need to be actively involved in hypothesizing. One way to increase student involvement is through teacher questioning. Ask the students why they selected a particular hypothesis. Encourage the students to make educated guesses without indicating whether a hypothesis is supported or not.

Testing the hypothesis depends on the evidence needed. The two most common forms for collecting evidence are through experimentation or through research based on "original" data. Original in the classroom context means something other than a textbook. Analysis of the data should mirror the methods common to the content area of the problem. The more you organize and manage the data, the smoother hypothesis testing will be. The computer and Internet make it possible to manage student data collection and analysis in a manner that cannot be duplicated using paper resources. Imagine conducting a social studies inquiry with 25 students, 8 different hypotheses, and limited copies of data sources. The data management and classroom management issues would prove overwhelming. Now, assume the data sources are available online and essentially infinite. The concern for where a data item is located becomes moot. When stored on a computer, data sources do not mysteriously disappear in student notebooks at the end of class, thus making that data unavailable for the next class.

Testing the hypothesis represents the bulk of student activity during an inquiry. Allocating sufficient time for student data collection and analysis is critical if students are to learn via the inquiry approach. The teacher's role during the testing step of inquiry includes 1) keeping students focused on the specific problem, 2) clarifying data, 3) providing support for data testing, and 4) seeking explanations of student actions. (Strasser, Dalis, Loggins, and Cowan, 1982) Remember, having your students acquire the "correct" answer is not the only goal in an inquiry lesson. Having students develop the skills required to provide a supportable explanation are also important inquiry learning outcomes.

Developing a conclusion involves supplying an answer. Similar to testing the hypothesis, the best approach is to use methods consistent with those employed in the problem area. For example, students in social studies can present a paper, the elementary science students can create a graph of the results, and language arts students might provide a written or oral presentation of their findings.

How to evaluate Inquiry

Assessment of student learning needs to take into account the processes the student(s) used during the inquiry activity. Limiting assessment to the correct answer sends a message to students that the process is not important. As such, traditional measurements such as short answer quizzes or tests of factual information are not sufficient. Asking students to provide explanations with supporting details is appropriate. Assessing inquiry processes may require conducting a similar inquiry to verify students can apply the skill of generating and testing hypotheses.

How can technology support the implementation of Inquiry?

For teachers, technology may be useful for presenting the problem to students. For students, technology may be useful for testing hypotheses through experimentation and online research. Technology can be useful for student development of conclusions in the form of information graphics, presentations, and paper reports.

TABLE 1
Technologies useful to inquiry lessons

Step	Technology
Presentation	Computer Probeware Video Word Processor (background materials) Power Point (other presentation software) Webquests Interactive white boards
Testing the Hypothesis & Applying the Conclusion	Computer Probeware Online Resources Spreadsheets
Applying the Conclusion	Interactive white boards Word Processors Power Point (other presentation software)

Technology How-to

Webquests, originated by Bernie Dodge (2007), are online activities that take advantage of data stored on the Internet to engage students in the processes of inquiry. Webquests follow steps such as: 1) Introduction, 2) Task, 3) Process, 4) Resources, 5) Evaluation, and 6) Conclusion. Not all Webquests are inquiries and not all inquiries are implemented as Webquests. However, the similarities between a Webquest and Beyer's inquiry model (See table 3) suggest that Webquest templates can be used to conduct Beyer model inquiry lessons. In this activity, you will transfer existing content to an online Webquest template.

TABLE 2
Comparison of Webquests and Beyer inquiry steps

WebQuest	Inquiry Model
Introduction – provide background	Define the problem
Task - a question is posed	Define the problem
Process - a set of directions and activities to solve the problem	Develop tentative answer
Resources - tools and web based information	Test tentative answer Develop Conclusion
Evaluation - criteria for assessing the quality of student processes	Evaluation of process and product implied
Conclusion - activities to encourage students to reflect on the Webquest experience	Apply Conclusion

To simplify the how-to process, a problem was selected for you. The problem revolves around the Anasazi civilization. Eight hundred years ago, tens of thousands of Anasazi lived in the area that comprises Arizona, Colorado, Utah and New Mexico. They built multistoried apartments, cliff dwelling and walled cities. Yet, a culture that lasted over a thousand years vanished within a couple generations. The students' task is to explain why this occurred.

Using the content provided in Appendix 7 you will cut and paste the text and

links into the Webquest template available at the Teach-nology website. Download the WebquestText.doc version of Appendix 5. from (http://prometheus.ed.csuohio.edu/EdTechPrimer/WebquestText.doc)

Open the WebquestText.doc file in MSWord.
Go to the http://www.teach-nology.com/web_tools/web_quest/

FIGURE 2
Teachnology webquest page

Scroll down on the web page and complete the following;

Step #1: Enter descriptors for the subject, name, and Title

Step #2: Select a picture for your Webquest.

Step #3: Copy the text provided for each category from the WebquestText.doc file and paste it into the corresponding category on the Teach-nology webpage.

Step #4: Click on the Generate-Web Quest button.

The Teach-nology site will generate a one-page Webquest. You can create a working version of this page by viewing the page source, copying the source code and then pasting the code into an HTML editor or web page design software. Once the file is saved, you can run the Webquest from any computer connected to the Internet by opening it from a browser such as Firefox or Explorer.

As you can see from the how-to activity, the technical skill required to generate a Webquest is minimal, but the planning and research required to find appropriate resources is time consuming.

Web Resources for Inquiry

There are so many web resources on inquiry that it is difficult to isolate general resources that are useful across all content areas and grade levels. The three links provided offer background on the inquiry model, descriptions of inquiry based instruction and links to sample lessons. An Internet search with Inquiry and your content area as keywords will provide numerous usable results. Like all Internet searches the quality and relevance of the results will vary from excellent to poor

Resource	Link
Inquiry Model background	http://www.thirteen.org/edonline/concept2class/inquiry/index.html
What is Inquiry-based instruction?	http://edis.ifas.ufl.edu/wc075
Links to inquiry lessons	http://www.indiana.edu/~oso/inq.htm

Suggested Activities

Activity 1

In this activity you will identify materials needed to plan an inquiry.

Step 1

List your content area.

Step 2

Identify a specific question within your content that requires an explanation.

Step 3

Indicate two or three hypotheses students can generate for the question identified in step 2.

Step 4

List a couple of examples of data or experiments that students need to perform in order to test the hypotheses identified in step 3.

Step 5

Indicate how you will present the problem question to capture students' attention.

Step 6

List and describe one or more technologies you can integrate into the lesson to improve the students ability to conduct the inquiry.

Activity 2

It is likely that you participated in a science related inquiry lesson at some point in your school experiences. It is less likely that you participated in an inquiry lesson in social studies, mathematics, English / language arts, or art. In this activity you will survey a language arts Webquest based in part on the novel **A Separate Peace: A Teenager Experiences World War II**. We suggest you conduct an Internet search for a Wikipedia summary or plot synopsis if you are not familiar with the novel.

Although **A Separate Peace: A Teenager Experiences World War II** provides questions for students, rather than having the students generate their own hypotheses, the Webquest promotes the collection of data, the analysis of evidence, and the development of a conclusion; processes that address the inquiry goal of explaining a specific problem,

Visit A Separate Peace: A Teenager Experiences World War II Webquest located at http://www.web-and-flow.com/members/shursey/separatepeace/webquest.htm. Consider the following questions. Can you identify activities that contribute to student inquiry? How did the Webquest creator ensure that the students had sufficient background to consider the question? How does this inquiry extend the students' understanding of the novel, **A Separate Peace: A Teenager Experiences World War II.**

References

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Strasser, H., Dalis, G.T., Loggins, D. and Cowan, R. (1982) *Teaching Behaviors related to the Dalstra inquiry teaching strategy*. (TSC 0882-25 Office of the Los Angeles County Superintendent of Schools, as part of the Dalstra ITS Program). Los Angeles, CA: Division of Curriculum and Instructional Strategies, Educational Services Group.

Chapter 7

Problem-based Learning

Student Directed Problem Solving

Problem solving has a long history in education. Problem-based learning (PBL), an instructional approach that encourages student-directed problem solving, builds on this tradition but expands on it in important ways. Namely, problem-based learning teaches problem solving skills and metacognitive skills concurrent with content instruction. This joint acquisition of problem solving skills, metacognitive skills, and content knowledge are central to the PBL model. This chapter provides an overview of problem-based learning and offers suggestions on how technology may complement PBL instruction.

What is problem-based learning?

Problem-based learning first appeared in the 1950's in medical education (Uden & Beaumont, 2006). Real medical problems were posed to students training to be doctors. Working in small groups, students analyzed and defined the problem, generated hypotheses, gathered information, proposed possible solutions, and evaluated those solutions to arrive at a resolution. In solving a problem, students learned medical content, but they also learned strategies they could apply to subsequent problems. Over time, the PBL model expanded beyond medical education into all content areas and all levels of education.

In PBL instruction, students receive an authentic problem early in an instructional unit. Learners are given access to information and resources related to the problem, guidance on strategies that can be used to identify possible solutions, and they are encouraged to work with each other and with experts to solve the problem. In this way, students learn content from grappling with problems. Unlike teacher directed models of instruction, PBL is student-centered and students are encouraged to take control and direct their own learning.

What are the benefits of problem-based learning?

The benefits of PBL are increased student engagement, collaboration, motivation, and interaction. Posing problems for learners to solve can be a catalyst to learning. Once a problem is identified, defined, and understood, it is difficult for most learners to resist the natural tendency to seek a solution. PBL problems are authentic. The interrelationships between the problem and real-life tend to increase student interest and participation in problem solving.

Planning for problem-based learning takes time and careful thought. As with all instructional planning, it is important to start by identifying learning outcomes. In other words, you need to decide what students will be able to do and what they will know by the end of a PBL unit. By its very nature, problem-based learning is complex. When confronted with a problem that we need to solve, we may consider multiple ways to go about solving the problem and there may be multiple solutions. Therefore, conducting PBL in the classroom may involve multiple learning outcomes and multiple content areas.

The problem posed to learners in a PBL environment is the critical instructional element, for it is the problem that defines what students learn and the degree to which students "own" the problem and are motivated to solve it. Characteristics of good problems include problems that are ill-defined, complex, authentic, and pertinent to the content areas being studied. Students need to be actively involved in solving the problems, so consider identifying problems that are controversial, mysterious, or puzzling.

Here's a PBL example based on the Ohio academic content standards for sixth grade students in language arts, social studies, and science. In language arts, among many other standards, sixth grade students learn how to

1. compare and contrast ideas and perspectives
2. analyze cause and effect
3. analyze information from maps, charts, tables, diagrams, and cutaways
4. summarize information

In addition, there are writing conventions that students need to demonstrate, such as using correct punctuation, citing resources, and using appropriate vocabulary. Some of the standards for sixth grade students in social studies include:

1. constructing a multi-level timeline and interpreting relationships knowing locations of countries
2. explaining how technological changes affect agriculture, manufacturing, fishing, and other activities analyzing maps
3. interpreting graphs
4. explaining how human modifications of the environment can have positive and negative effects using multiple sources to obtain information and vocabulary

Science standards, as with all the content standards, encompass multiple areas. In science, these areas include life sciences, earth and space science, physical science, science and technology, scientific inquiry, and scientific ways of knowing. For sixth grade students, some of the standards include:

1. explaining the difference between nonrenewable and renewable resources
2. describing how technology influences the quality of life
3. describing how decisions can result in both positive and negative consequences creating a solution to a problem

Using these learning outcomes as a starting point, how can you plan a problem-based learning unit? One strategy is to simply brainstorm ideas. Since PBL requires a problem, you need to identify a problem. Brainstorming allows for multiple ideas to be suggested so that the ideas can then be analyzed in order to select one or more ideas that warrant further investigation.

Another strategy is to search for problems that currently exist in the school or in the community. Using problems that exist in a familiar setting will make the problem relevant and engaging to students. Since most of the students will be aware of the problem, the students may already be interested in solving it.

A third strategy is to use resources that contain suggested problem-based learning scenarios that can be adapted to fit a particular grade level or content area. There are books and Internet resources devoted to problem-based learning where you will find problems that have been used successfully in the

classroom. An Internet search with the keywords "PBL and lessons" will provide numerous examples to consider. Adding a keyword for a content area such as "PBL, lessons and ecology" will refine the search further.

A fourth option is to use existing resources, such as the Union of International Association's (UIA) World Problems database. Let's assume you searched the UIA Internet database (see http://www.uia.org) for a problem to pose to sixth grade students. In browsing the subjects, you selected "Transportation," and then "Cycling". Most sixth grade students ride bicycles so the topic is authentic. Listed under the topic of Cycling is a problem labeled "Discouragement of bicycles."

The UIA database usually provides a description of the nature of the problem and where it occurs. Here is abbreviated information for the problem Discouragement of bicycles from the UIA database:

Nature

The normal urban environment is not designed for bicycles. On roads they are threatened by cars, and bicycles on paths and pavements threaten pedestrians. Bicycles are also threatened by parked cars as they make it difficult for the rider to see other people and for other people to see him. Many of the inevitable accidents between cyclists and automobiles and larger vehicles cause fatal or serious injuries and almost invariably these are only to the riders of the bicycles.

Incidence

Asian countries like China and India depend overwhelmingly on human-powered vehicles. Together the two largest Third World countries have 600 million bicycles but less than one percent of the world's automobiles. But cars and buses are fast replacing bicycles, rickshaws… An extract from an official report reads: "The traffic role of bicycles will gradually phase out when urban transport becomes modernized... (In the West, bicycles) have already been reduced to being tools of sports, recreation and tourism. Such examples should serve as our reference

in the planning of our future urban development. (Union of International Associations. World Problems – Issues.

Retrieved from (http://www.uia.be/sites/uia.be/db/db/x.php?dbcode=pr&subject=2512&go=e&id=11657170)

The problem described in the UIA database is complex. Think of all the issues related to the reduction of the use of bicycles in China. There will be impacts in manufacturing, economics, energy needs, business, banking, environmental factors, and society in general. One way to use this world problem in the classroom is to create a guiding question. One such question is, "What impact will the elimination of bicycles have in China?" From this starting point, many different classroom investigations are possible and multiple learning outcomes can be addressed.

The bicycle problem is authentic and may be of interest to students. As the teacher, your question might be; how is the problem of eliminating bicycles in China related to the curriculum standards in language arts, social studies, and science? Table 1, Selected Curriculum Examples, suggests how the problem might be incorporated into content instruction.

TABLE 1
Selected Curriculum Examples

Curriculum Standard	Examples
Language Arts - compare and contrast ideas and perspectives	Have students investigate the reasons why the Chinese government wants cars to replace bicycles. Additionally, students can try to find information about what the citizens of China think about abandoning bicycles. As students gather information, they can be guided to analyze the information, identify different perspectives, and compare ideas. Consider having students debate the different perspectives they find, or create persuasive posters arguing for or against a particular idea.
Social Studies - explain how technological changes affect agriculture, manufacturing, fishing, and other activities	In their investigation of bicycle use, students can identify the impact of cars on agriculture (e.g., air pollution, fewer people to work in agriculture), manufacturing (e.g., more people in large cities thus creating a larger workforce, workers can travel longer distances to get to work if using cars, more asphalt and concrete needed to build and maintain roads), fishing (e.g., air pollution, better and faster transportation of fish to markets), and other activities, such as family life.
Science- explain the difference between nonrenewable and renewable resources	With the increased use of cars, nonrenewable resources will be in higher demand in China. What effect will this have on the rest of the world? How will natural resources in China be affected?

Throughout this example, there are places where the curriculum standards among language arts, social studies, and science overlap. The overlap adds to the richness and complexity of the problem and encourages students and teachers to build multiple skills as well as to develop a more comprehensive understanding of the problem.

You need to carefully plan what you want students to do and provide ways for them to be successful in PBL. Engage other teachers in your planning as they can often suggest ideas and strategies. Involve the school librarian, too. Consider how technology may be integrated into the problem to make it

more authentic to students. In particular, use technology tools that experts in the problem solving area would use. Use of these tools will make the activity more authentic. As important as student engagement is, it is more important to plan for academic rigor in PBL, as learning may be limited if you have not thought through what students do during problem solving. Identifying what the students will know and be able to do at the conclusion of problem solving will help you to develop assessment rubrics and will clarify the academic purpose of the PBL instruction.

How do you implement problem-based learning?

Every problem-based learning activity will be different; however, three types of support are worth incorporating into every PBL implementation.

Provide problem background so that students understand and are curious about the problem.

Provide resources, tools, and methods so students can address the problem in a meaningful way.

Provide identifiable guidelines for assessment so students understand the expectations for successful problem resolution.

If you are new to PBL, a practical recommendation is to start small. Begin with a problem that has clear boundaries. You may want to identify a problem in your school. Perhaps there is a problem with cell phone use. Students can investigate the problem and propose solutions that are then presented to school administrators and/or parents. Or, students might investigate food served in the cafeteria and come up with ways that the cafeteria can increase the nutritional levels of the food.

Five components are common in PBL lesson implementation; problem identification, problem source, data collection, data analysis and problem resolution. In problem identification students are made aware of the problem. In problem source students offer their initial impressions of the problem and pos-

sible solutions. In data collection the students identify, gather, and apply the resources, tools, and methods needed to tackle the problem. In data analysis they interpret the results of data collection. In problem resolution they identify and support their solution and present their findings. The application of the components will vary based on the problem posed, but these components offer a guideline for initial PBL implementation.

How do you evaluate problem-based learning?

Since PBL focuses on solutions to problems, traditional forms of evaluation such as short answer and multiple-choice tests may not be the best way to evaluate student knowledge. Evaluations based on projects or student presentations of their proposed solution are more appropriate since they can reveal a wider range of knowledge and skills considered in the problem solving effort. For example, students may make a presentation to their classmates, people in the community, or school administrators. Students may compose letters to be sent to governmental agencies or to people who hold governmental offices. Students may build a prototype to represent their proposed solution. Evaluation options for problem-based learning are considerable.

What content-specific information will students need to know? Will you be looking at student products to insure that students have correctly understood the relevant content? Do you want to evaluate the quality of the proposed solution? If so, you will need some way to look at quality, perhaps through a rubric where you identify essential criteria the solution needs to include. Will you grade students on how well they worked in groups or on the quality of their writing? The key is to tie the evaluation to the knowledge and skill goals identified for the PBL activity.

Given the complexity of problem solving, there are multiple considerations in PBL evaluation. By starting small, you will be able to focus on one or two assessments, then, as you gain in knowledge and experience, you can add other assessments to your PBL lessons.

How does technology support problem-based learning?

There are three areas where technology supports PBL. Technology can be used to:

1. Find problems (e.g., using the UIA database of world problems, searching the Internet, etc…);

2. Locate online resources (e.g., library resources such as InfOhio, relevant informational web sites, relevant multimedia, including images, audio files, and animations)

3. Provide tools that students may use to solve problems and to present results (e.g., word processor, spreadsheet, database software, presentation software, communication tools, image manipulation tools, animation software, simulation software, computer probeware, and tools that allow for collaboration.)

Technology - How - to

How one integrates technology into a PBL lesson is dependent on the type of problem posed. The following example represents a problem currently found in many school settings, a problem that students will view as authentic. The problem is "How can we reduce the amount of litter on school grounds?" This PBL example is geared to a 4th grade student audience. However, the problem could be posed at any grade.

In this example, in order for students to support their recommendations, they will need to collect data, portray the data, interpret the data, suggest solutions, and report their findings. Five technology tools (projectors, digital cameras, graphic software, spreadsheets, and word processors) are appropriate to solving the litter problem. Remember, PBL lessons may range from simple to complex. The schoolyard litter problem represents a simple, yet genuine problem.

Step 1

Problem identification

The students may or may not be aware that a litter problem exists, but taking them out on the school grounds may be time consuming, and the distraction of being outdoors may detract from a focus on the litter problem. Instead, consider taking photographs of specific locations in the schoolyard where litter accumulates. The photos may be placed in a presentation and projected for the class to view. Students are then asked what is similar across the photos. The litter problem becomes obvious and the question of how to reduce the litter is posed.

Step 2

Problem source

Students will have suggestions regardless of whether a problem is simple or complex. Allowing for an initial discussion of the problem is reasonable, as it will point to the types of data required to test whether or not student suggestions are supported.

Step 3

Data Collection

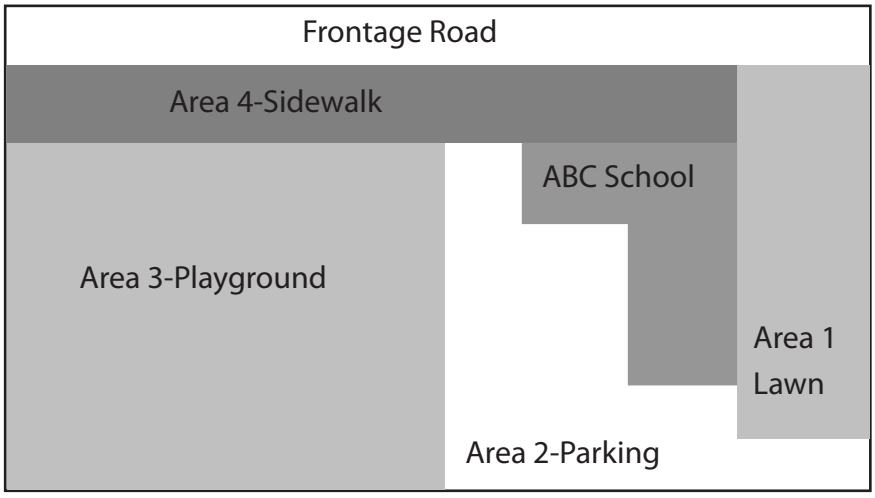
The type and form of data collection will vary with the problem posed and the student grade level. Providing structure to the litter problem will make it manageable while still supporting problem solving at a 4th grade student level. Three important variables in the schoolyard litter problem are: the quantity of the litter; the type of litter; the location of the litter. Two of the variables may be considered by providing the students with a map of the schoolyard. (see Figure 1.) The map is created with basic graphics software such as the drawing tools provided with most word processors and projected for all to see. Each section in the map describes a distinct school area. For example, Area 1

is where bus drop-off and pick-up occurs and Area 4 includes the sidewalk students use to walk to school. Even though students know the schoolyard, each area and its boundaries are described. Provide a print version of the map during data collection.

By establishing areas based on teacher knowledge of the problem, the location variable is constrained without informing students of the implications. For example, it may be that more litter accumulates in Area 4 (the sidewalk) than in Area 1 (bus drop-off) because students drop food wrappers as they walk. As such, in order for students to pose reasonable solutions, careful thought is required to establish areas for data collection. Lastly, the type of litter needs to be identified. For simplicity, three types might be identified for the 4th grade students, paper, plastic, and other. Instructions and warnings must be provided so students do not collect objects such as broken glass or other dangerous materials.

The data collection may commence once the students are provided with gloves, trash bags, and directions for counting and identifying the litter.

Figure 1
School Map



Step 4.

Data Analysis

The counts of the litter collected are completed by the students and double-checked for accuracy. A spreadsheet with the litter counts for each area is projected. (see Figure 2.) Students are then asked if the data meets their expectations.

Figure 2

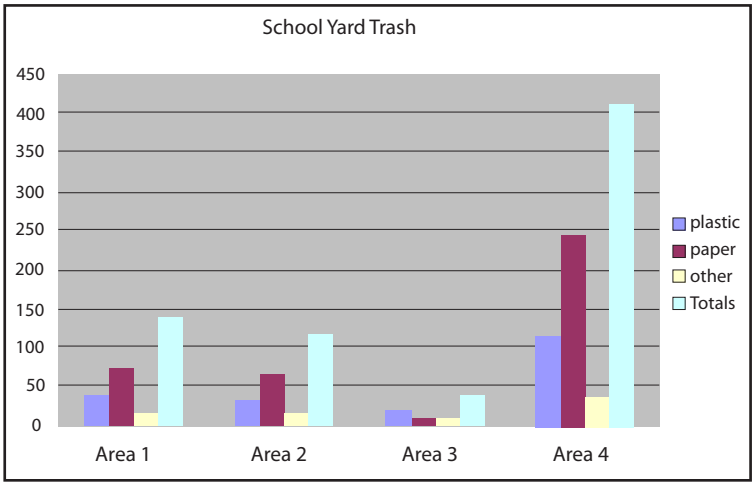
Litter Spreadsheet

	A	B	C	D	E	F
1	**School Trash Chart**					
2						
3		**Area Count**	**plastic**	**paper**	**other**	**Totals**
4		Area 1	43	78	22	143
5		Area 2	33	65	17	115
6		Area 3	22	12	13	47
7		Area 4	120	250	45	415

A graph is generated from the data and projected. Online sites such as Create a Graph may be used to collect and graph data in lieu of a spreadsheet. See figure 3. At this point, you can ask students why they think the counts are high for one area and low for another.

Figure 3

Litter Graph



Step 5.

Problem Resolution

Students are asked to explain ways the litter may have gotten into each of the four locations and then to brainstorm solutions to eliminate the litter problem in each location. After small group discussion, the class can create a list of reasons how the litter came to be in each area. Projecting the list for all to see ensures that the class understands the reasons. Next, students can list and project their solutions. Lastly, students can create litter reduction recommendations for submission to the school principal. This litter problem lesson may take two to three class sessions to complete.

Web Resources for PBL

Internet resources

An excellent resource for identifying real-world problems is an online database maintained by the Union of International Associations (UIA), an organization based in Belgium. UIA's database of world problems contains information about thousands of existing problems found all over the world. If you use the UIA database to find problems for classroom adaptation, It is usually best to browse through the topics. You can also search by subject.

To access the Union of International Association's database of world problems, go to **http://www.uia.org.** Click on "Databases" and choose "Legacy (still maintained)." Now click on "World Problems – Issues." Browse by "Subject."

A URL to a short video clip that shows how to browse the UIA database: **http://faculty.kent.edu/ckovalik/tag_book/uia_database_descrip.swf**

University of Delaware web site devoted to PBL **http://www.udel.edu/pbl/**

An online article from 1998 that defines and discusses PBL **http://www.ntlf.com/html/pi/9812/pbl_1.htm**

Suggested Activities

Before you begin a PBL activity based on an authentic scenario, consider planning a hypothetical lesson. It is a great way to learn the basics of PBL. This activity provides a five step process to determine if an activity is appropriate for PBL. Select a grade level and a content area and then complete the following steps.

Problem Identification

Identify a problem in one or more content areas that grade-level appropriate. Indicate how you might present the problem to students. Indicate what resources, tools and knowledge the students need to solve the problem.

Problem Source

List some solutions the students may suggest before they start problem solving. Indicate how you can engage the students in the problem.

Data Collection

List the types of data the students need to solve the problem. Indicate how technological tools can be used to collect the data. Describe how you will guide the students to collect data.

Data Analysis

List some forms of data analysis that are appropriate to the problem and within your students' ability. Indicate how technology may be used to analyze the data. Describe how you will guide the students to analyze the data.

Problem Resolution

Describe what the students will submit as the culmination of the problem solving activity. Identify three criteria you plan to use in the evaluation of student solutions.

References

Uden, L. & Beaumont, C. (2006) *Technology and problem based learning*, Hershey, PA: Information Science Publishing.

Union of International Associations.(2001). *World problems –issues online*. Retrieved from http://www.uia.be/sites/uiabe/db/db/x.php?dbcode=pr&subject=2512&go=e&id=11657170

Chapter 8

Process Writing

Revise, Revise, Revise

Writing occurs in all content areas at every grade level, but what works for one student may not work for another. Some students research topics thoroughly before writing. Others like to let their ideas flow without regard for writing conventions. Despite the differences in how students compose a written product, capable writers agree that revision is an integral part of the process.

Prior to the later part of the last century most writing instruction emphasized grammatical rules, syntax, vocabulary, and other component parts of finished compositions. This component approach to writing instruction possessed merit, but writing requires language skills and thinking processes that extend beyond surface level writing conventions. Process writing is an instructional approach that shifts the focus of writing from the attributes of finished compositions to the processes that lead a student from initial idea to a polished final product. This chapter presents a simplified version of process writing as an alternative approach to writing instruction and describes how technology tools may support writing instruction.

Process Writing -What is the Instructional Approach?

Process writing instruction involves leading students through a series of strategic steps where they generate and organize ideas, create written drafts, edit their writing and produce a polished final copy. Like other instructional models, proponents of the process writing approach suggest different methods. Five steps (1) Pre-writing, (2) Drafting, (3) Revising, (4) Editing, and (5)Publishing are frequently identified in writing process models.(Angelfire, 2001) Each step emphasizes a different aspect of the writing process while providing students with a roadmap for creating a polished final product. As an introduction to process writing instruction, this chapter simplifies the five steps into three stages: pre-writing, writing, and revising.

What are the benefits of the Process Writing ?

Because process writing emphasizes communicating ideas over surface level writing conventions, students learn to focus on the purpose of writing. Through guided writing experiences, the process writing approach teaches students a model of writing that is consistent with how capable writers write. By teaching grammar in the context of writing, students learn standard conventions as part of the process of writing, thus making it easier for students to remember grammatical principles. The process writing approach also encourages preparation prior to writing. This preparation makes it easier for students to prepare initial drafts. Lastly, through rewriting, students learn how revision can improve the quality of a final product.

How do you plan for process writing?

How you plan a process writing lesson will vary depending on your students' writing ability and the purpose of the writing activity. Are your students writing in a journal, writing a letter, writing a research report, writing a biography, or writing poetry. Each type of writing requires slightly different

planning. However, the three stages: pre writing, writing and revising should be planned regardless of the type of writing.

Pre writing considers what students do prior to placing ideas on paper. Pre-writing strategies include brainstorming, concept mapping, journaling, writing logs, and outlining. Brainstorming is a way to gather ideas on a particular topic. This may be planned for individuals or for the whole class. During brainstorming, students suggest ideas that are recorded with limited or no modifications. Interactive white boards or other forms of computer projection are useful technologies to list students' ideas. Concept mapping is a variation on brainstorming that provides additional support for student understanding by clustering similar information together. Journaling, having students document their ideas in a notebook, is a popular technique to help students organize information on a specific topic. A secondary benefit of journaling is that it encourages students to write more often, thus improving their ideas without concern for writing conventions such as spelling, punctuation and grammar. You may have your students write in a journal everyday, every other day, or once a week. How often the students write is dependent on your writing goals. Writing logs are similar to journals but they emphasize what the students already know about a topic and typically include responses to teacher questions. Outlining is a traditional method of pre writing. However, outlining assumes that the writer possesses sufficient knowledge of a subject to identify and organize the main and supporting ideas. Most word processing programs include an outline feature that reduces some of the apprehension students may have regarding the formatting conventions of outlines. However, students still need knowledge of the content to create a meaningful outline. Complementing one pre writing approach with another is acceptable, for example, following a brainstorming session with a concept mapping activity.

The key to success in pre writing is to determine what type of activity best supports the writing purpose and then to plan accordingly. It makes sense to consider brainstorming when students know little about a topic. Journaling is an appropriate pre writing activity when a topic extends over a longer instructional period because journaling offers students multiple opportunities to record their impressions.

It is not sufficient to simply assign a pre writing activity. Students need to see what the processes of pre-writing entail, so modeling how-to techniques is necessary when introducing pre writing. As your students gain experience and confidence in pre-writing, the amount of planning you need to do for pre-writing will decrease.

The writing stage is about placing ideas onto paper. It sounds straightforward, but writing may be difficult for some students. Even students who have successful pre writing experiences may hold the misconception that their first draft is also their final draft. To ensure that students understand that revision is inevitable, you should consider planning writing activities that encourage students to write often so that they get their ideas on paper without regard for form or writing conventions. Activities such as stream-of-consciousness writing or timed freewriting are useful exercises for initiating writing and for convincing students that revision is a natural part of the writing process. Having students write online or post writing to the web may increase student motivation. Online locations for writing include Google Docs, and numerous blog and Wiki sites. Google Docs is a free online word processor that supports collaborative writing and provides online storage of documents. Blogs or web-logs are web pages that allow authors to post comments or reflections to a website. Wikis are web pages that support collaborative writing and editing. The best-known wiki is Wikipedia, but for teachers setting up class wiki provides greater opportunities for student writing. A key benefit of Google Docs, blogs, wikis and other forms of online writing is that you can monitor student submissions. As such, unlike hand-written materials that are only available when turned in, you can review online writing and support students' efforts during the writing process.

The purpose of the writing stage, whether completed in class, home or online, is a readable rough draft. Therefore, planning clear writing directions geared toward your students and the assignment's goals is critical to the writing stage.

Revising involves modifying style, tone, vocabulary, sequence and proofreading to correct errors in punctuation, spelling and grammar. Revision activities should be planned, as revision may not occur without teacher assistance.

Teacher conferences, and peer editing are common revision activities. Both activities involve reading and offering feedback to the author. Planning for a day to a week between initial draft and rewriting provides students with enough time for them to view their writing anew. Multiple rewrites should be scheduled as part of the revision stage. Planning instruction on how to proofread, i.e., the elimination of technical errors, will help students to learn accepted writing conventions. Also, preparing a checklist, rubric, or other clearly defined criteria will help students to identify and correct common writing errors.

Pre writing, writing, and revision will not occur without teacher support. Planning instructional activities to guide students through the writing process is the first step.

How to implement Process Writing

Word processors are the most common technology integrated in process writing instruction. The primary impediment to implementing word processors is keyboarding ability. Students who lack keyboarding skills will face the added frustration of slow typing, which in turn will reduce their ability to get ideas on to paper quickly. As such, pre-writing and writing activities that require keyboarding skills should be limited to students with acceptable keyboarding skills. Keyboarding may also be problematic for younger children whose hands are not large enough to touch type on a standard keyboard. Consider recruiting parents, instructional aides, older students, or other typing volunteers for students who lack keyboard skills.

Lots of options exist for implementing technology in pre-writing. As mentioned in the planning section, using an interactive white board with groups is an effective way to brainstorm ideas. The white board software also allows you to save information. As such, students who were absent, or students who need additional support during pre-writing may refer to the saved file to generate writing ideas. Concept mapping software (see chapter 5. Advance Organizer) may be implemented to generate pre-writing ideas. A common variation on concept mapping is the story web. Sharing a blank story web (see figure 1) with students provides just enough support to get

students to think about sequencing their ideas. Story webs for other types of writing activities are available online. A keyword search with "story webs" will provide numerous examples. Other options for pre-writing with technology include KWL charts (Table 1). KWL charts may be created in a word processor or interactive white board and shared with students to organize information on a topic. Journaling may be conducted electronically as students become increasingly comfortable with keyboarding. The availability of online storage of journal files in wikis, blogs and Google Docs make it easier to maintain journals, but online options do require reliable Internet access. The lack of a sufficient number of computers may also be a stumbling block to implementing electronic journaling in the classroom.

FIGURE 1

Sample Story Webs

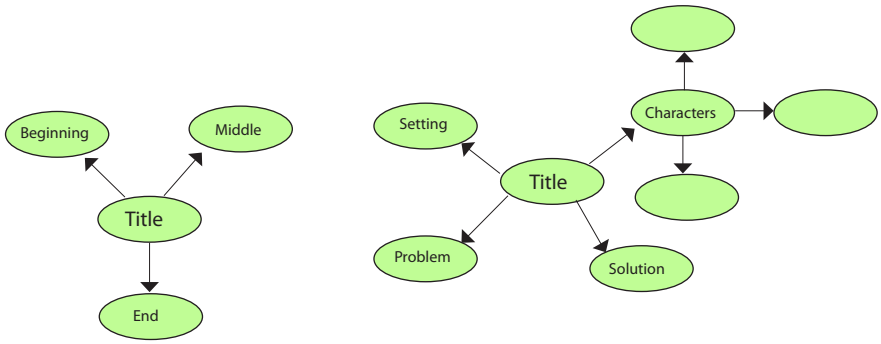


TABLE 1

KWL Chart

KWL Chart		
K What We Know	W What We Want to Find Out	L What We Learned

Word processors are the most common form of implementation for the writing stage. Assuming students have access to computers and adequate keyboarding skills, word processors can simplify the writing process. Specialized software applications have also proven effective in writing instruction. For example, programs such as comic strip generators, animation, video editing and desktop publishing software may be used to motivate and engage students in writing.

One of the simple yet powerful techniques to employ when implementing the revising stage is to provide time between the initial draft and rewriting. Separating the writer from the draft makes it easier for the writer to notice issues with completeness of thought, errors in organization, and to recognize grammar and syntax problems.

Feedback is critical to the implementation of the revision stage. Two forms of feedback, 1) student/teacher conferences and 2) peer editing are common in classroom instruction. The conference approach is useful even when students are still working on initial drafts especially with shorter writing assignments that may be read quickly. The conference typically focuses on meaning and purpose rather than the mechanics of the writing. You read the draft and provide feedback to the students directly. Technology supports conferences by allowing students to submit digital text files for review. In addition, most word processing programs provide utilities for text markup. Online applications such as Google Docs offer support for documenting and saving revisions. A key benefit of using technology for revision is that the student's original version remains intact.

Peer editing feedback serves several functions. First, it lets the students know that they have a real audience for their writing. Second, they benefit from their peers' responses. Third, they learn to recognize good writing by reading, responding to, and identifying other students' writing problems.

Proofreading involves the elimination of surface level writing errors. Proofreading may take place during conferences and peer editing or as a specific activity prior to submission of a final version. Word processing tools such as a spell checker, grammar checker, dictionary, and the thesaurus simplify proofreading for students.

How to evaluate Process Writing

Today most word processors have more features than what most students or teachers will ever need. It is easy for students to become enamored with features such as fonts, styles, and drawing tools. Your task is to keep the focus of word processor use on communicating a written message. Establishing evaluation criteria focused on the quality of the written message will help you to control the tendency of students to emphasize the appearance or formatting of word processed writing.

A rubric is a useful tool for evaluating many types of learning outcomes, especially outcomes that include subjective judgments like process writing. A rubric consists of a set of criteria and standards for performance. See Table 2. Normally, students have access to the rubric so that lesson expectations are clear. By identifying criteria for assessment in advance of a writing lesson, a rubric ties the planning, implementing and evaluation of a lesson together. The rubric accomplishes this by clarifying the level of expectation for the learning outcomes that, in turn, point out what needs to be taught to achieve the expectations. The level of detail in a rubric will vary based on the learning outcomes. Rubrics may be created using the table feature in a word processor, a spreadsheet or by using one of the online rubric generators. Rubistar, a website sponsored by 4Teachers.org is a popular site for creating rubrics for many content areas. Besides rubrics, many forms of evaluation such as checklists, assessment conferences, and trait scoring are suitable for assessment of student writing. Like rubrics, the more closely the evaluation matches the learning outcomes the more appropriate the evaluation will be.

TABLE 2

Rubric for a three paragraph descriptive writing assignmnent

Rubric for a three paragraph descriptive writing assignment.					
Criteria	**5 points**	**3.5 points**	**2 points**	**0 points**	**Comments**
Drafts	Multiple drafts provided, record of conference with teacher	Multiple drafts provided.	One draft provided.	No drafts.	
Final Version	Easy to follow. Good grammar, syntax, punctuation and sequence.	Easy to follow. Acceptable grammar, syntax, punctuation and sequence.	Difficult to follow. Acceptable grammar, syntax, punctuation and sequence.	Difficult to follow. Poor grammar, syntax, punctuation and sequence	
Originality	Includes original details and descriptions supportive of paragraph focus.	Includes a few original details and descriptions supportive of paragraph focus.	Original details and descriptions, but not supportive of paragraph focus.	Little evidence of originality.	
Criteria	**2.5 points**	**2 points**	**1 point**	**0 points**	
Brainstorm	N/A	N/A	List Provided.	No list	
Concept Map	Provided, concepts clustered in a meaningful manner.	N/A	Provided, concepts not clustered in a meaningful manner.	None provided	
Focus	Paragraphs 1, 2 &3 match order and purpose	N/A	Paragraphs 1, 2 &3 related to meal criteria.	Paragraphs not focused on meal.	

The Internet has made it easier for students to find source materials for writing assignments. Unfortunately, the ability to cut and paste content from electronic sources has also made it easier for students to plagiarize. Some school districts use sites such as Turnitin.com to check student work. Turnitin.com compares a student's work to examples in the Turnitin.com database and to materials available on the web. It returns a statistical analysis of the student's work that you may review to verify originality. Turnitin.com is a fee-based service. Teachers who do not have access to the service, but still wish to evaluate student work for plagiarism may search on Google or other search engines using selected quotes from the student work to check if the quote appears on the Internet.

How can technology support instruction with Process Writing?

As noted previously, word processors are the primary technology associated with writing. Table 3 includes examples of technology tools that support the writing process.

TABLE 3
Sample technology tools that support the writing process.

Stages	Technology
Pre-writing	Word Processors – Ex. Word, Keynote, Google Docs Concept Mapping Software Interactive white boards
Writing	Word Processors Writing Software – The Essay Writer, Ultimate Writing and Creativity Center, Comic Life, Final Draft
Revising	Word Processors – spell check, grammar check, thesaurus, dictionary, etc Desktop Publishing Software, Ex. Microsoft Publisher

Technology - How - to

In this activity you will write a three-paragraph description of a memorable meal. The focus of the description is on the food you ate, not the event where the meal was eaten. Before you begin the description, review the assessment rubric in Table 2.

Pre writing

Using any word processor, brainstorm a list of as many details of the food that you remember. Record every detail that comes to mind. Don't worry if some of the ideas do not seem to fit. You will select the details that work best later. Save the list.

Group the details you listed into the following categories: Appearance, Smell, Taste, Texture and Other. Feel free to add any new details that come to mind. You may organize the details into the categories using concept mapping software, a table in your word processor or the outline option in your word processor. If you do not own concept mapping software consider using bubbl.us, an online concept mapping software. Save the file you create.

Writing

Using the concept map or outline you created in the pre-writing activity, draft a three-paragraph description of the food. In paragraph one describe the appearance of the dish. In paragraph two describe the smell and taste of the dish. In paragraph three indicate what made the dish so memorable. Your draft may be done in any word processor or you may set up a Google Docs account. Save the draft.

Revising

Let your draft sit for at least one day, then read your draft out loud. After you have read the draft, make any changes to improve the descriptions or to clarify the meaning. Share the second revision of your paper and the checklist (See Table 3.) with a peer editor. Review the completed checklist and comments, then revise the draft. After you have completed the draft use the spell and grammar checker in your word processor to ensure that punctuation and spelling are correct and that standard language is used.

TABLE 4

Draft checklist for peer editors

Draft checklist for peer editors				
Draft Checklist		Yes	Sort of	No
Paragraph 1	I can visualize the appearance of the food.			
Paragraph 2	I can almost smell or taste the food.			
Paragraph 3	I can understand why the meal was unforgettable.			
Originality	The descriptions were creative.			
Organization	The ideas are presented in a logical manner.			
Style	Good choice of words and/or figurative language.			
Comments				

As you can see from the activity, technology serves primarily as a tool to support the writing process. It does not generate the ideas or write the composition. However, the more comfortable your students become with the technology tools that support writing, the easier it will be to produce writing that communicates a message.

Web Resources for Process Writing

Everyday, it seems like more writing applications are available. An Internet search for "process writing tools" will provide links to free and commercial products to assist in the writing process. An Internet search for "process writing lessons" results in thousands of lessons. Refining the search by grade level or topic will limit your search results. Like all searches for web resources, it is your responsibility to test the applications and review the lessons you find, prior to student use. The following resources represent resources used by many K-12 teachers of writing.

Google Docs – is an online word processor. In addition to word processing tools, the application supports collaborative writing (one or more writers or editors) and stores files online.

Google Blogger – is an online utility that allows users to create their own web logs – blogs. Blogs may be set up as online student journals with access limited to the student and the instructor, or they may be open for public viewing.

Wikispaces – is one of many online utilities that allow users to create their own wiki – a site that supports input from multiple writers. Wikis may be set up as a location for students to publish their writing and/or to receive feedback on their writing.

Turnitin.com – is a plagiarism detector. Teachers submit student work to the site where it is reviewed electronically for plagiarism. The site provides detailed statistics on written submissions. The Turnitin.com site requires a fee.

Purdue Online Writing Lab (OWL) – is the online writing lab of Purdue University. A wide range of writing resoures are available at the site.

National Writing Project – a resources website dedicated to improving writing in schools.

Squidoo Interactive Writing Tools – provides links to interactive writing tools.

WWW.readwritethink.org - offers classroom resources, including lessons plans and interactive tools.

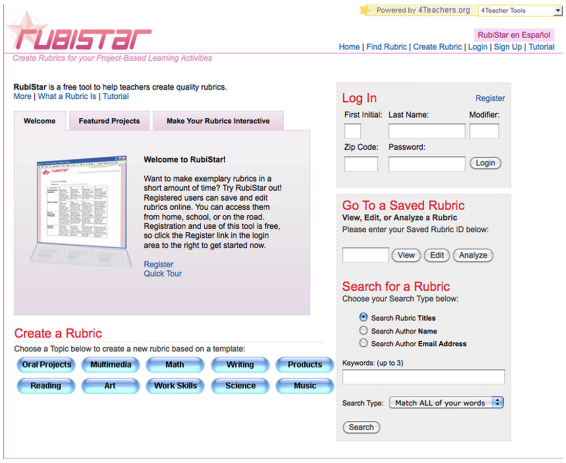
Suggested Activities

Activity 1

Your task is to create a rubric for a creative writing activity. Rather than creating an original one, you will use the Rubistar website located at http://rubistar.4teachers.org/ to generate one from a template. (see figure 2.) You do not need to complete a user log-in to create a temporary rubric. Click on the "Writing" button to generate a story-writing rubric.

FIGURE 2

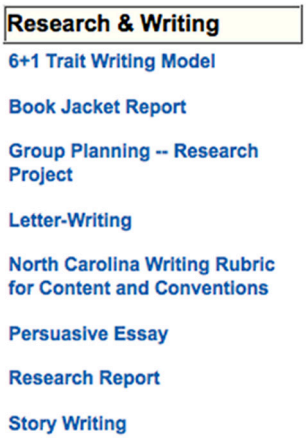
Rubistar Homepage



Click on the "Story Writing" link listed in the "Research & Writing" column. From this screen you will enter information about yourself. Select "Yes, my rubric is a demonstration rubric" from the drop-down menu. In "Categories" under "Please Choose" (see figure 3.) you will find a drop-down menu with criteria to consider for your rubric.

FIGURE 3

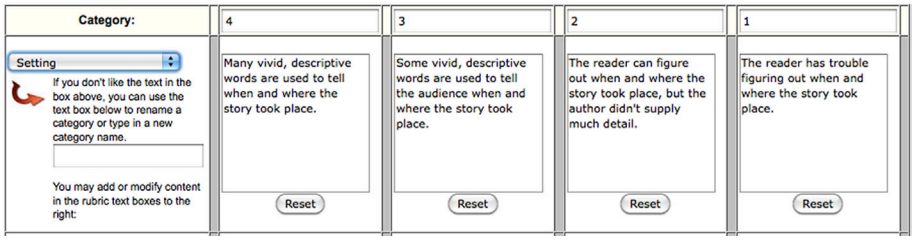
Story Writing Categories



Choose "Setting" as your first category. After your selection the criteria are set by Rubistar. Note, you are allowed to edit the criteria. Choose "Characters", and "Dialogue" for your other rubric categories. Then scroll to the bottom of the page and click on the "Submit" button.

FIGURE 4

Setting Criteria



The rubric you create can be printed or downloaded. (see figure 5)

FIGURE 5
Completed Story Writing Rubric

Story Writing: Sample
Teacher Name: Joe Blue

Student Name: _____

Category	4	3	2	1
Setting	Many vivid, descriptive words are used to tell audience when and where the story took place.	Some vivid, descriptive words are used to tell the audience when and where the story took place.	The reader can figure out when and where the story took place, but the author didn't supply much detail	The reader has trouble figuring out when and where the story took place.
Characters	The main characters are named and clearly described in text as well as pictures. Most readers could describe the characters accurately.	The main characters are named and described. Most readers would have some idea of what the characters looked like.	The main characters are named. The reader knows very little about the characters.	It is hard to tell who the main characters are.
Dialogue	There is an appropriate amount of dialogue to bring the characters to life and it is always clear which character is speaking.	There is too much dialogue in this story, but it is always clear which character is speaking.	There is not quite enough dialogue in this story, but it is always clear which character is speaking	It is not clear which character is speaking

Activity 2

Select one of the three stages: pre writing, writing or revising, and indicate how technology might assist with instruction in that stage.

References

Lipkewich, A. E. & Mazurenko, R. (2001) *ABC'S of the writing process*. Retrieved from http://www.angelfire.com/wi/writingprocess/

Chapter 9

Creativity

Imagine That!

The previous chapters presented simplified instructional approaches and provided examples of how to integrate technology into these approaches. The instructional technology examples reflect competencies that are within the reach of a novice teacher. As you develop your teaching repertoire, you will expand your technology knowledge and skills beyond these baseline competencies and develop your own innovative ways to integrate technology into instruction. Over time, the creative methods you employ will increase and so too will student engagement and motivation.

Creativity is not limited to teachers. Children should have opportunities to be imaginative and creative, too. Kindergarten students enter school eager to learn and full of questions. Unfortunately, imagination and creativity seem less apparent as students advance through the educational system. In part, the reduction in student creativity is a function of teaching measurable learning outcomes that emphasize convergent thinking. Fortunately, groups within the educational community have recognized the need for instruction in creative thinking. For example, the national call from the Partnership for 21st Century Skills (2010) is to build a community of learners, which have critical thinking, problem solving, communication, collaboration, creativity and innovation skills to compete in a global economy. Knowing that creativity is a crucial skill makes it worth teaching, but what is creativity? In an educational context, creativity is defined, as "a way of thinking or acting or making something that is original for the individual and valued by that person or others" (Mayesky, 1998, p. 4). Imagination is defined as "the ability to form images and ideas in the mind, especially of things never seen or not experienced directly"(Esbin, 2007/2008, p. 24). This chapter describes creative techniques you may incorporate into your instruction and provides examples of technological tools that may be useful in teaching creative process skills to students.

Creativity is not an instructional model designated by a set of steps, rather it is an approach to instruction that encourages students to think differently. Unlike traditional instruction, which encourages convergent thinking, creativity requires learning environments that support divergent thinking. To cultivate divergent thinking, two conditions are necessary: 1) you need to teach creatively and 2) students must take part in creative learning experiences. To promote individual thinking and creativity in the classroom, you need to be student-centered and value ingenuity.

How do you teach creatively and how do you encourage student creativity? As you become more confident in your teaching ability, you will try different instructional methods. Some instructional methods you will learn from colleagues, other methods you will learn during professional development experiences, and still others you will discover on your own. The learning outcomes promoted by the methods will be the primary difference between these new instructional methods and the ones with which you are already familiar. In creative lessons, the learning outcomes will be more open-ended and expressive than what can be captured by performance objectives. You should consider problem solving objectives to assess your creative learning outcomes (see Appendix 1.) As you move from convergent learning outcomes to more divergent learning outcomes, your instructional techniques will adapt to support the creativity necessary for students to acquire the more open-ended outcomes.

Technology offers potential for moving instruction in a creative direction, but not every attempt to use technology in a creative way will prove successful. You have to be willing to experiment to determine whether a technology will work in your classroom. However, not all of your experimentation needs to be original. Searches on the Internet for creative lesson plans will produce numerous results. As with all Internet searches, you need to review the search results to ensure the lessons you find address the desired learning outcomes. If a lesson does not match the learning outcomes, you may need to revise the lesson for your audience.

Another way to develop creative lessons is to research how experts in your content area are trained or how those experts problem solve. Do the experts employ specific methods or technology while they work? Can the

methods or technology be adapted for students at your grade level? Do the professionals upgrade their knowledge and skills via immersive instruction such as using case studies, internships, job shadowing, or computer modeling? For example, professionals in many fields employ computer simulations to test theories and designs. K-12 simulations are available online for science, mathematics, social studies, and many other content areas. A computer simulation may be available to engage your students in a particular learning outcome. For example, numerous online stock market simulations are available for classroom instruction.

The reality of today's classroom imposes challenges to creative teaching approaches which are also complementary to technological innovation. (Grainger, Barnes & Scoffham, 2004). Even after you become successful at teaching creatively, you will still face the problem of balancing the tension between measurable learning outcomes and the development of creative teaching approaches. In addition, creative methods may seem foreign to your students. Additional time may be needed to orient your students to the new methods and expectations. There is no single way to become a more creative teacher, but it helps to be a risk-taker.

What are the benefits of creativity in instruction?

Instruction that encourages creativity increases student engagement and motivation. As the world shifts to a knowledge-driven economy, Robinson (2001) believes, "human skills and people's power of creativity and imagination" become increasingly important to prepare students for the changing economic environment (as cited in Grainger, Barnes, and Scoffham, 2004, p. 244). Teaching creativity can be an innovative way to engage students in learning how to learn. Also, creative processes and skills that students acquire may be used in settings beyond the classroom.

How to plan for creativity

The constraints of teaching to specific academic standards sometimes limit opportunities for students to engage in creativity. As such, lacking experiences in thinking creatively, students may be deficient in the skills required for

creativity. Planning creativity must take into account the teaching of creativity skills. In addition, you need to create a safe environment for creative expression. Students need to understand that taking risks is acceptable and as the teacher you must model risk taking for your students.

Challenging the status quo is one of the first steps in planning creative instruction. Understanding your students' comfort with, and understanding of, creative processes is the second step. To reduce the potential for confusion, students need to know general techniques for creative problem solving and you need to include instruction in creative problem solving techniques in student learning experiences. Table 1, adapted from Torrance (1977) lists selected techniques to consider when planning creative learning experiences. The example provided with each technique represents one possibility among many.

TABLE 1

General creative problem solving techniques.

	Technique	Sample of how to address
Before	Clarify the topic to reduce ambiguities	Provide a rubric with expectations.
Before	Explain multiple answers are acceptable.	Share forms of acceptable answers.
Before	Encourage students to provide direction for research.	Survey students for research topics.
During	Make students aware of issues inherent to the problem	Ask leading questions.
During	Encourage student exploration of unrelated elements.	Allow a student to research dead-ends.
During	Encourage the visualization of events, places, etc.	Encourage sketching, graphing, etc.
After	Discuss the ambiguities and uncertainties encountered.	Debrief – what worked and why.
After	Expand possible solutions.	Apply what is learned to like problems.
After	Make predictions / projections	Discuss class results and alternatives.

Planning a creative lesson takes time. Implementing a lesson, including one or more of Torrance's (1977) techniques, allows you to see which techniques are most useful for your lesson content and students. After a lesson implementation and reflection, you may need to revise the lesson to take into account what was learned. Over time, the Before, During and After activities will become embedded into classroom practice, and both you and your students will expand the use of the creative techniques. In Appendix X there is a sample lesson plan appropriate for middle school or high school English/history classes, which engages students in a range of creative activities.

How to implement Creativity

Each teacher has his/her own unique way of teaching. The research (Esbin, 2007/2008; Umbach, 2008) on creativity suggests that the following procedures and principles facilitate creative thinking and behavior in students. These ideas are widely established within the research on creative thinking and creative problem-solving but originate from E. Paul Torrance (1970, 1977, 1991) who is considered a leading authority on creativity in the classroom.

Warm up your audience

Students need time to consider possible solutions to creatively posed problems. The time when we ask a question in the classroom and wait for an answer is often referred to as 'wait time'. With creative thinking, students need more than wait time. They need activities to 'stretch the mind.' Puzzles, brain-teasers, and other quick activities provided at the outset of a creative thinking and problem-solving lesson are useful to prime students to engage in 'divergent thinking" when exploring possible solutions. When conducting warm up activities, use examples sparingly as sometimes an example may decrease innovation, creativity, and divergent thinking, since the example locks the student into believing that the example is the 'most correct' or 'only' way to solve the problem.

Give purpose to creative writing

Writing is a form of communication and requires background and thought to convey a coherent statement to a reader. Include purposeful reading as part of

the writing process. A creative writing project should emphasize the communication of ideas rather than grammar and syntax since follow-up editing can polish the writing but will have limited effect on the quality and originality of the idea.

Interact with the environment to be studied. There are multiple ways in which students interact with the environment and content. The more opportunities that students have to interact with a topic, situation, or object, the more likely they are to creatively describe and elaborate on the topic, situation, or object. Incorporating a variety of learning modes into lesson implementation encourages creativity. In addition to linguistic and mathematical modes of learning consider including vision, touch, smell, and hearing learning modes.

Be constructive in analysis

A constructive attitude toward a topic tends to generate a larger number of ideas and creative solutions as opposed to asking students to be critical. Use positive language rather than negative language. For example, 'construct new ideas about the topic' rather than 'critically analyze a topic'.

Be careful of evaluative comments

Too much evaluation, criticism, and correction can decrease students' creativity. Continuous evaluation slows learning and may interfere with student performance. Suspend judgment on evaluation as you walk around the room and observe student progress. Provide sufficient time for students to work through the creative process.

Don't evaluate everything.

Encourage 'just for fun' activities with younger students. When unevaluated practice is followed by a task similar to the unevaluated practice, achievement may be increased and student work may be more creative.

Reward original thinking

Students need to know that creative thinking is valued and rewarded. A classroom with the established practice of helping students think of original

and unusual ideas will produce work that is more expressive, descriptive, and imaginative (Torrance 1970, 1977, 1991).

How to evaluate creativity learning outcomes

Assessing creativity is as challenging as trying to define creativity or implementing it in instruction. One tool for evaluating creative processes is a rubric. A rubric includes criteria for the acceptable completion of an assignment. Rubrics may be designed to evaluate the creative components of learning outcomes. Once you know the criteria required to define a creative end product, defining the criteria for acceptable and sub-optimal end product are feasible. Rubric criteria may include processes such as the originality of students' ideas or the relationship of a student's original idea to the final product. Identifying the processes that students need to exhibit to be creative may be more complicated than identifying what makes a quality end product, but it is doable. Some creative processes to consider include: having students explain the steps they followed to solve a problem or create a product, having students record the ideas they discarded, having students list the ideas that influenced their decision making, and having students list other possible solutions. What you include in your rubric will vary based on the lesson. Rubrics provide a reference for students when they first attempt creative activities.

How can technology support the implementation of creativity?

All of the instructional approaches considered in prior chapters may be adapted to creative instruction supported by technology. (See table 2.)

TABLE 2
Sample creative technology uses

Approach	Original Example	Creative Example
Presentations	Media limited slide presentation	Animation style presentations
Instructional Graphics	Teacher created print handouts	Student created graphics
Direct Instruction	Power Point Jeopardy style review.	Online educational games
Advance Organizer	Concept Mapping	Web-base interactive timelines
Data Collection and Analysis	Spreadsheets and computer probes	Computer simulations
Inquiry	Webquests	Online experts
Problem Based learning	Spreadsheet	Computer modeling
Process Writing	Word Processing	Video Production

Technology can 'spark' a student's imagination through greater interactivity. New technologies appear on the web every day. Go2Web20 located at http://www.go2web20.net/ provides hundreds of web-based applications for consideration. Most of the applications were not designed for classroom use, but many may be adapted for instruction. In addition, organizations such as the National Council of the Teachers of Mathematics, the National Science Teachers Association, the National Council for the Social Studies, International Reading Association, the National Writing Project and many other professional organizations offer links to creative lessons and novel technologies from their websites.

Technology can also be used to support creative lessons through the use of wikis (journaling), blogs (debates, conflict resolution), Internet research (locating sites to support writing, data collection, journals, evaluation and creativity), writing within the curriculum (research papers, presentations) and/or identifying background information to lay a foundation of future work.

How to Integrate Technology into a Creative Lesson

Watching and creating videos is motivating for many students. YouTube provides evidence that technology tools have made it possible for anyone to be a video producer. Although the messages and the production values of the videos posted on YouTube are suspect, the success of the site suggests that video can offer an outlet for student creativity.

In chapter 8, process writing was presented as pre-writing, writing and revising. Video and film production phases offer comparable processes of pre-production, production and post-production. (see table 3.) The similarities between writing and video production offer the potential for conducting video versions of process writing that allow for greater student creativity.

TABLE 3
Comparison of process writing and video production phases

Process Writing	Video
Pre-writing – gathering and organizing ideas	Pre-production – gathering ideas, preparing the script, developing storyboards, preparing a shot list and responsibilities
Writing – placing ideas on paper to create a draft	Production – recording the video footage
Revising – modifying and polishing the draft to produce a final copy.	Post-production – editing the recorded footage to produce a final copy.

Teachers who are interested in conducting video production in lessons should consider searching the Internet with the keyword phrases "classroom video production" or "digital storytelling" (see table 4) The sites identified by the searches will provide both a context for conducting video production in the classroom, and ideas for lessons. Teachers unfamiliar with video production will find tutorials for video post-production software, online, such as

Macintosh iMovie, and Windows Movie Maker. Practicing with the video editing software available to you will prepare you for assisting your students with technical questions related to video post-production.

TABLE 4
Online Resources for classroom video production

Resource	Description
Center for Media Literacy	Organization dedicated to promote media literacy. Article on video basics and production projects - http://www.medialit.org/reading-room/video-basics-and-production-projects-classroom
Video 101	Tutorials on the fundamentals of video production - http://www.video101course.com /
Edutopia.	The George Lucas Educational Foundation site. How to use digital storytelling in your classroom - http://www.edutopia.org/use-digital-storytelling-classroom .
Center for Digital Storytelling	A non-profit organization dedicated to assisting people in using digital media to tell stories - http://www.storycenter.org/index1.html

Directions are provided in Appendix 7 for a video how-to activity that follows a three-phase video production process comparable to the writing process. The steps lead you to produce a public service announcement.

Web Resources for Creativity in the Classroom

The following videos and sites provide additional thoughts about how you can use technology to become a 21st Century teacher and engage your learners in the use of technology for creative endeavors.

21st Century Teacher
http://www.youtube.com/watch?v=5KmYHDNB-Uc&NR=1&feature=fvwp

Classroom Innovation
http://www.youtube.com/watch?v=oxYhLDHC1VM
Wikis: A Platform for Innovation in the Classroom
http://www.youtube.com/watch?v=ELwWDrIkSnI

Engaging Tools to Foster Creativity
http://www.wiziq.com/tutorial/54417-Engaging-Internet-Tools-to-Foster-Creativity

Thinking about Digital Learners
http://www.marcprensky.com/

Suggested Activities

Examine the following sites for ideas regarding the integration of technology into creative lessons.

Wikis for Collaboration in the K-12 Classroom

http://wik.ed.uiuc.edu/index.php/Wiki_in_a_K-12_classroom

Integrating 21st Century Skills in a Classroom Project Using Blogging: This site provides a variety of tools for helping teachers to creatively integrate 21st Century skills into the classroom using blogs and journaling.

http://www.wvcpd.org/PLAJournal/ActionResearch-BloggingProject/Action-Research-BloggingProject/BloggingProject.htm

How to Keep an Inventors Log Book: This site provides a primer on developing an inventors log book which may be used in a wide variety of content areas as a means of improving not only 'creative thinking' but writing skills as well. The second URL provides a wealth of activities for creative thinking and inventing.

http://inventors.about.com/cs/logbook/ht/Log_book.htm
http://inventors.about.com/od/lessonplans/a/creativity.htm

SCRATCH: This open source software developed at MIT allows students to build video games to share on the web. These games can incorporate content, video, music, sound and are shared with others on the MIT site. The site has complete guides and tutorials for encouraging those 'gamers' in your classroom to explore the world of programming.

http://scratch.mit.edu/

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Appendix 1

Learning Outcomes

Introductory Statement

The goal of every lesson is to help students to acquire knowledge, to develop a new skill, or to modify a behavior. The changes in student knowledge, skills or behavior represent the learning outcome of a lesson. Sometimes learning outcomes are well defined – the ability to tie one's shoe. Other times, learning outcomes are complex – the ability to design an experiment to test a hypothesis. No matter the level of complexity, identifying student learning outcomes is the first step in lesson planning

New teachers sometimes find it difficult to determine learning outcomes. This is understandable as there are many variables to consider. Often, the new teacher becomes distracted by implementation details. How do I introduce the materials? How do I engage the students? How do I integrate technology into the lesson? How do I evaluate what the students have learned? The "How" list is daunting. However, after you have identified learning outcomes, it becomes easier to identify what methods support the outcomes, how and if technology may enhance students' acquisition of the learning outcomes and what type of evaluation best suits your learning outcomes.

Teachers have considered learning outcomes since the time that lessons were first written. Unfortunately, there is no single agreed upon form to address all the different learning outcomes we expect of students. A variety of learning outcome types exists, each with different emphases and different names. Common forms include performance objectives,

problem-solving objectives, behavioral objectives, enabling objectives, terminal objectives, instructional objectives, expressive outcomes, etc. To simplify matters this text considers two types of learning outcomes, 1) performance objectives and 2) problem-solving objectives.

Performance Objectives

Performance objectives represent the most common type of student learning outcomes considered in K-12 schools. For introductory purposes, performance objectives are characterized by the following conditions:

1. Performance in student terms
2. Observable / measurable (performance)
3. Indication of the conditions
4. Criterion for measurement

Consider the following performance objective:
The student will be able to create an Excel grade book based on scores from 4 tests for twenty students. The grade book will have student names listed in one column, assignments listed in one row, and average and total scores based on Excel functions for each student.

Each section of the objective addresses one of the performance objective conditions.

Performance in student terms - The student will be able to
Observable / measurable (performance) - create an Excel grade book
Indication of the conditions - based on scores from 4 tests for twenty students.
Criterion for measurement - The grade book will have student names listed in one column, assignments listed in one row, and average and total scores based on Excel functions for each student.

The strength of performance objectives is clarity. Both the teacher and the student know what is required to meet the objective. In addition, the teacher can determine from the performance objective what prerequisites skills are needed to perform the task and what instruction is required in order for the students to acquire those skills.

Performance objectives are appropriate when the learning outcome represents an accepted answer. For example, performance objectives for spelling, subtraction, or word processing are reasonable because each example could be written in such a manner as to have the performance reflected in an agreed upon answer. The results from the spelling, subtraction and word processing examples are observable – the words are spelled correctly, the numbers are subtracted correctly, the margins are 1". The conditions for the spelling and subtraction might be with paper and pencil. The conditions for the word processing might be using MS Word software. The criterion for all might be with 100% accuracy.

Good performance objectives require more than simply meeting the four characterizing points. The performance objective must also capture the meaning embedded in the learning outcome. So, in the Excel grade book performance objective example, if my general learning outcome is that students should be able to enter data and simple formulas into a spreadsheet, then the characteristics listed for the performance objective fit, but if my learning outcome was for student's to develop the skills necessary to create a personal budget spreadsheet, then the performance objective would need to be rewritten, because even though it addresses all four criteria, it does not capture the learning outcomes of creating a personal budget.

Problem Solving Objectives

Performance objectives address many learning outcomes, but not everything taught in preK-12 settings results in an explicit answer based on detailed objective criteria. For example, students might be asked to write a historical essay. Essays written by the two students might offer opposing viewpoints on a historical question, yet both could represent acceptable solutions. For open-ended learning outcomes, such as the essay example, performance objectives may not be appropriate. A problem solving objective offers an alternative to the performance objective in cases where more than one solution is acceptable or when the criteria for achieving the learning outcome includes both objective and open-ended criteria. In problem solving objectives, students formulate or are given a problem to solve, the criteria that needs to be met to solve the problem are relatively clear, and the paths to an acceptable solution are numerous. (Eisner)

Problem-Solving Objectives (Goals) are characterized by:

Posed problem
Criteria for resolution
Numerous forms for a solution

Consider the following problem solving objective:
The student will create a Power Point presentation on a historical figure from colonial times, the presentation will include biographical information, information on the impact of the figure on American history, an introduction, body and conclusion, a minimum of six slides including a title and references, slide text may not be read to the class, last no longer than 10 minutes, but more than of 5 minutes, the presentation may include any combination of text, audio, images, video and print materials.

Posed problem - The student will create a Power Point presentation on historical figure from colonial times,

Criteria for resolution - the presentation will include biographical information, information on the impact of the figure on American history, an introduction, body and conclusion, a minimum of six slides including a title and references, slide text may not be read to the class, last no longer than 10 minutes but more than of 5 minutes,

Numerous forms for a solution - the presentation may include any combination of text, audio, images, video and print
materials.

Like the performance objective, the problem-solving objective examines what the student will be like at the conclusion of instruction, but the criteria are more open-ended to address the wider scope of acceptable solutions.

Variations of performance objectives and problem solving objectives exist, as well as other types of learning outcomes. However, provided you are aware

that variations exist, performance objectives and problem solving objectives will suffice for introductory purposes. The key message is to identify your learning outcomes - what you want your students to know or be able to do when instruction is complete and then to plan your instruction accordingly.

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Appendix 2

Presentation Tools

Presentation Rubric

Category				
Points	.5	.25	0	Score
Checklist	Checklist complete.	Checklist incomplete.	Checklist not included.	
Readability	Uses bulleted simple phrases or short sentences.	Organization of text haphazard.	Too much text crammed on page.	
Font	Size large enough for group presentation (titles & text)	San Serif or easy to read font.	Difficult to read-All Caps, too small, etc.	
Contrast	Background and text colors with strong contrast.	Text readable over background.	Background and text conflict-limited contrast.	
Title Slide	Included and consistent.	Included but consistent.	Title slide-missing.	
Organization	Order is logical and sequential. Easy to follow.	One or two slides out of order.	Slides appear out of order.	
Consistency	Layout consistent throughout.	Layout consistent throughout with minor problems, fonts, colors, size, etc.	No underlying layout across the slides.	
Graphics	Enhances message-aids comprehension. Supports educational message.	Appropriate but has problems - ex size, clarity, pixelated,etc.	Purpose not discernible.	
Effects & Transitions	Consistent and meaningful across presentation.	Minor problems -inconsistent across presentation, distracting, etc.	Lack purpose.	
Points	1.5			
Rough Draft	Thumbnail sketches with slide ideas or outline.	Single example of prior work (sketch or file.)	No draft material created.	
Points	2	1	0	
Content	Message/purpose is accurate and matches audience.	Message/purpose apparent. Information correct.	No clear what the message/purpose is.	
Overall Presentation	Final version professional in appearance. Free of errors. Orginal work	Minor inconsistencies with appearance.	Lack in care in production. Grammar, spelling, visual, other errors.	
Total Score				

Presentation Planning Checklist

Activity	Comments	Y/N
List key message(s) you plan to communicate		
Identify/describe the audience you plan to teach		
Determine tone of presentation		
Identify the sources		
Collect an prepare content, notes, and questions		
Create thumbnails sketches or storyboards		
Determine sequence of content		
Select design layouts		
Add content to individual slides		
Test, archive, and revise		

Sample Questions for Predator / Prey Presentation
Questions for generalizing the experiment

1. Who is likely to survive?
2. Who is likely to reproduce?
3. What variations are more likely to expressed in the next generation?

Questions to check knowledge of concept

Bluefin tuna can swim at speeds over 30 knots. Suppose their ancestors swam at a much slower speed. The ability to swim fast probably:

1. developed for all tuna in a couple generations
2. *involved the increase in the percentage of tuna that can swim faster.

Sample Questions for Predator / Prey Presentation

Questions for generalizing the experiment

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Questions to check knowledge of concept

Bluefin tuna can swim at speeds over 30 knots. Suppose their ancestors swam at a much slower speed. The ability to swim fast probably:
developed for all tuna in a couple generations
*involved the increase in the percentage of tuna that can swim faster.

BECAUSE
*there was first a random genetic difference in a few
the more the tuna used their muscles, the faster they all became
the need to catch prey caused them to swim faster

Many years ago the pesticide DDT controlled the spread of mosquitoes. Recently, chemists have found that mosquitoes do not seem to be harmed as much by DDT. The reason for this change is that:
*the mosquitoes that were affected died. The once who weren't affected lived.
over the years the mosquitoes became resistant to DDT

BECAUSE
*the individual mosquitoes who survived the DDT had offspring
the need to survive caused the mosquitoes to change
the use of DDT lead to a mutation in the DNA of the mosquitoes

The * indicates the correct answer.

Downloadable Files for Presentation

Link to predSpread.png and predGraph.pict

Appendix 3

Instructional Graphics

Sample Instructional Graphic Rubric

Category				
Points	1	.5	0	Score
Audience Indicated	Good fit between audience and graphic content	Audience identified but not well matched to content	Audience not apparent	
Purpose Indicated	Type of content matches purpose-description, tabulation, exploration, or decoration	Purpose stated but not well matched to content	Content matches purpose	
Points	2	1.5	0	
Design & Layout	Uncluttered presentation of data, design does not distort the content	Layout clean and clear. Focus on key information. Graphics and verbal information complement one another	Layout jumbled. No focus	
Content	Content is accurate and matches audience	Content apparent. Information correct	Not clear what the content is	
Points	3	2	0	
Overall Graphic	Final version professional in appearance. Explains data by itself.	Draft materials included. Product revised and polished. Sources of material provided	No planning or draft material evident. Lack of care in production. Sources not provided	
Total Score				

Appendix 4

Concept Development

Activity Directions

This art example was selected because it may be completed with little or no background knowledge of art. Your task is to describe the key attributes of a style of painting by viewing positive examples of the style. Non-examples of the style of painting are also presented to help you to determine what is not important in the style.

Remember, concept development is about process as well as product, so you may need to examine numerous examples before the style of painting begins to define itself. You are encouraged to work with other students, as it is much easier to find similarities and differences when several people compare their ideas. In other words, you will be making comparisons to decide what is important to this style of painting and what is not important. When you have viewed the examples and recorded your thoughts, you should be able to write a paragraph describing the key attributes of this style of painting.

Style of Painting - Concept Development

Download and Print the practice grids. (CDArtGrids.doc)
Downloads available at http://prometheus.ed.csuohio.edu/edtechprimer/downloads.html
Place the grids in front of you – positive examples on the left and non-examples on the right.

Positive Examples

Name	Type of Brush Stroke	Emphasis of light	Subject Matter	Uses/ types of color
Grand Canal Venice	*Visible, no attempt to hide.*	*Light seems delicate, changing, other-worldly.*	*Day scene of Venice.*	*Pastel like colors.*
Ships and Sailing Boats Leaving Le Havre				
Le Orangers				
The Boating Party				
The Dance Lesson				
Women Seated Under the Willows				
The Artist's Daughter with a Parakeet				
Country Women Chat-ting Sunset Eragny				
Girl with a Basket of Fish				
The Church at Moret				
Young Woman with Peonies				

Non-Examples (These examples do not represent the style of painting)

Name	Type of Brush Stroke	Emphasis of light	Subject Matter	Uses/ types of color
In the Car	*Does' nt look like a brush.,looks like printed on paper.*	*Looks flat*	*People-cartoon like.*	*Mostly primary color and shades of gray.*
Guernica				
Night Hawks				
July 4th				
The Invalid				
Scylla				
Lady MacBeth Seizing the Dagger				
The Crucifixtion of Saint Peter				
The "Lean Diet" with Cooking Utensil				
Bildnis Fritza Riedler				

1. Open an Internet browser
2. Click on the link to the "The Grand Canal" Sample answers are provided for this painting. Feel free to change the answers if your interpretation of the brush stroke, light, subject and color is different.
3. Click on the link to the "In the Car", the first non-example. Sample answers are provided for this painting too. Feel free to change the answers if your interpretation of the brush stroke, light, subject and color is different.
4. Continue viewing examples. We recommend that you switch between positive examples and non-examples.
5. Enter your interpretations into the grids for each category for each painting. Don't worry if the language you use is simple. It will take many examples for the concept to emerge.
6. Examine your entries for the positive examples to see what appears consistently across the grid, after you have viewed each example and recorded your interpretations for each cell in the matrix.
7. Use the attributes listed at the top of the columns to describe the style of painting.

Appendix 5

Video How-To

Your task is to create a public service announcement warning students to keep track of their belongings so they do not disappear. The length of your video should be 30 to 45 seconds. Keeping video productions short force you to focus on the message rather than the medium. The short length also addresses the reality of the limited time available in class to conduct video activities.

This how-to is separated into three phases; pre-production, production and post-production. All that is required for pre-production is a pencil and some ideas. Production requires access to a video camera compatible with digital editing software, collaborators to serve as actors, and a location to record the video. Post-production requires the use of video editing software. Two common video editing packages are the iMovie for the Macintosh and the Movie Maker for Windows. Before attempting this how-to activity, if you are not familiar with your software, try one or more of the tutorials available online. You do not need to be an expert, but you should feel comfortable using the software.

We provided the message for the public service announcement and this reduces the time required for the how-to activity. Adding structure is necessary the first time you attempt a video production, otherwise students may generate ideas that are beyond the capabilities of your software or the time available. Keep in mind that student video production lessons take more time than you think. Read through the steps for each phase and complete each item as outlined below.

Pre-Production

Step 1.

Identify the message you wish to communicate through the video. For this activity the message is provided for you – avoid thefts of opportunity.

Step 2.

Sequence the message into a storyboard.

Story Line – you are creating a public service announcement on avoiding thefts of opportunity –- leaving a purse, book, computer, etc in a public location, or other situation where a theft occurs because the opportunity presents itself for someone to steal something without pre-planning the theft. There are many ways to communicate the message. The example of leaving something behind was only for explanation purposes; you should devise your own example. Brainstorm an idea for a theft of opportunity with students then add rough sketches to the boxes provided (or provide them with a blank storyboard template) below to visually depict the action in a storyboard format. Stick figures will suffice.

Clip #1 - Establishing Shot

Sketch the location where the theft occurs.

Clip # - 2 Medium shot

Create a focal point within the establishing shot (clip 1). Consider a medium shot of the individual who will be the victim of the theft, or as an alternative a medium shot of the person who will steal the item. It is up to you. Consider emphasizing the victim or robber over the item to be stolen. You decide if you want the stolen item visible in this clip.

Clip # - 3 Close Up

The audience needs to see the item that will be stolen. Make sure the item is in the location described in clips 1 & 2. A simple reference like an identifiable tabletop, floor covering, chair, etc will suffice.

Clip # - 4 Re-establishing Shot

Provide the situation for the theft; one possibility is a distraction. This re-establishing shot can be similar to clip 1 or in a different location with a different focus. For example, create an establishing shot of a restroom. Create a medium shot of someone entering a stall, then move to a close

up of a book bag outside stall. Create a re-establish shot with someone grabbing the book bag. Next create an establishing shot of the cafeteria, and a medium shot of someone eating. Do a close up of a book bag by a chair, and then a re-establishing shot of someone calling the book bag owner from another table

Clips # - 5- 7 (mixed types of shots)

Create a series of 1 to 3 clips that move the owner, or the owner's attention away from the item to be stolen and allow time for the theft. Additional storyboard blanks may be created if needed to tell the story completely.

Clip # - 8 Medium / Wide Shot (re-establish)

For this next clip, move the focus from the victim to the object of the theft.

Clip # 9 Close Up / Medium Shot

Emphasize the item being stolen (in this example the book bag).

Clip # 10 Wide / Medium Shot (re-establish)

Establish that the thief is leaving the scene of the crime with the book bag in hand.

Step 3.

Write narration and or titles.
The sketches in the storyboard clips should tell a visual story without the need for audio. However, you may script dialogue or narration to accompany the story.

Step 4.

Review / Determine shots and angles.
Review each frame of the storyboard and decide on the camera angles you will use. Note, pre-production decisions may change during production, but it saves time when students begin the production phase with a plan.

In an actual lesson rather than a "how-to" lesson, you would provide greater autonomy for student pre-production.

Production

Step #1

Conduct basic video recording operations.
Verify that the video equipment including camera, cables, batteries, tripods and recording medium are in working order. Organize all props required by the storyboard. Create duplicates of the storyboard for field use.

Step #2

Manage the video shoot.
Go to the location identified in the storyboard. Using the storyboard, stage each video clip. Review the staging directions with the talent. Record each clip. Review the recorded clips on location to verify acceptability of the audio and video. If necessary, re-shoot questionable clips.

Post-Production

Step #1

Conduct basic video editing operations.
Load the video clips into the software. Edit the video clips according to the storyboard or revised storyboard. Edit audio levels to ensure sound quality. Add titles, narration, effects and transitions. Save the video to the computer. Export the video to a viewable format.

The post-production listing seems straightforward, but like the revising phase in process writing, the post-production phase in video production can involve considerable revising and polishing.

Use the rubric in Table 1 to assess your completed public service announcement.

Table 1
Public Service Announcement Scoring Rubric

Category	0	1	2	Score
Length	Lasts longer than 45 seconds and or not related to message-avoid thefts of opportunity.	Lasts less than 20 seconds and or message evident but not clear.	Lasts between 30-45 seconds and message is clear and concise.	
Pre-Production	No Storyboard.	Storyboard provided.	Storyboard provided with production details evident for each video clip.	
Production	Sloppy camera work. (shaky, fast pans, bad angles etc)	Attempt to address basic camera techniques.	Controlled camera work.	
Post-Production	Editing, effects, transitions,and titles appear arbitrary.	Editing, effects, transitions,and titles flow together.	Editing, effects, transitions,and titles flow together and complement story.	
Creativity	Story completely predictable.	Story interesting/ surprising twists in story	Story presented in unexpected or novel way.	
Total Score				

Appendix 6

Lesson Plan

The Civil War: Where English, History and Mystery Converge
(Appropriate for middle school or high school English/history classes)

Kloehn, L. (2009). Imagination and learning: Students living "real" lives during the Civil War. English Journal, 99.2, 37-41. Permission to adapt from Ms. Lori Kloehn, author, email correspondence: February 18, 2010

Helping students with English writing skills can be a challenge. Bringing history into the mix can often spur the imaginations of our students and create an environment in which creative writing can flourish.

This activity uses the Internet, Civil War documents and a mystery to encourage students to envision the Civil War era and write about life during this period. The idea of 'pen-pals' supports the writing activity and the Internet brings critical documents to the student for analysis and prediction of activities of the Civil War.

Before the Lesson:

Take time to identify characters from the Civil War from the states of Ohio, Pennsylvania, and Tennessee. Additional characters may be needed depending on class size. These individuals may be real or fictitious depending on your desire to develop characters and character backgrounds. Some examples of fictitious characters might include: Jefferson Q. Slaughter IV, a plantation owner from Mississippi; Charity Taggart, a farmwife from Wisconsin; Sarah Arnold a freed black laundress from Delaware; Anthony Stevens, a Vermont Navy captain; Martin L. White a chaplain from Pennsylvania; or Maria Chaves who runs a ranch in New Mexico. It is important that the characters be spread throughout the country and rep-

resent a variety of ethnicities and professions. [Note: At times teachers have had students create the characters and build a background for the character – this depends on the age and ability level of the student.]

Remind students about issues during the Civil War period and provided them with links to review those issues if necessary. This activity may be an interdisciplinary work with a history teacher as well. For example, the sites below can be used to provide background information about the Civil War. Consider asking students to locate other sites so that these may be collected and shared with the entire class. You can assign a team of students the task of placing identified sites into a spreadsheet. Post the spreadsheet to a common location, possibly on Google Docs, to allow others to change the spreadsheet as additional sites are identified.

Civil War reference sites:

American Civil War: http://en.wikipedia.org/wiki/American_Civil_War.

The American Civil War Homepage: http://sunsite.utk.edu/civil-war/.

Civil War Images: http://images.google.com/images?q=The+American+Civil+War&oe=utf-8&client=firefox-a&rlz=1R1GGLL_en___US367&um=1&ie=UTF-8&ei=PA58S_lGifCUB_WvoKUF&sa=X&oi=image_result_group&ct=title&resnum=4&ved=0CCcQsAQwAw.

The American Civil War History Timeline: http://americancivilwar.com/.

The American Civil War: Maps and Documents: http://americancivilwar.com/civil.html.

Index of Civil War Information on the Internet: http://www.civilwarhome.com/indexcivilwarinfo.htm.

Civil War Diaries, Memoires: http://www.homepages.dsu.edu/JANKEJ/CIVILWAR/diaries.htm.

Civil War Letters: http://solomon.cwld.alexanderstreet.com/

Divide the class into half Southern citizens and half Northern citizens and randomly draw names to select the character each student will portray.

As a whole group activity, identify information that might become part of a that character's biography and background.

Review the writing process for creating a biography.

Identify (or create) a wiki site for students to use and have each student create their own account. Students will use the wiki to maintain the evolving biography over the course of the lesson. Criteria for the wiki should include the insertion of pictures, references to events in the biography, and images of the homes, clothing and links to events from the Civil War that are relevant to the student's Civil war character.

Using shoeboxes create mailboxes. Each mailbox should have the character's name on the mail box. Students will write letters as Northerners and Southerners.

During the Lesson

Once a student has a character, he/she is instructed to write a biography for the character using the Internet for research and a wiki for the writing activity. Students use the wiki to write about the character. The teacher should suggest that the biography describe the character's past, where they grew up, the family situation, their politics, social life, homestead, etc to fully develop the character.

a. Sample excerpt from a biography: Anthony Stevens, a Vermont man, came from a family in the dairy business that ran transportation along the Champlain Canal. Anthony describes his life of maple syrup, cheese, harsh winters, and liberal politics. Captain Stevens is from a family of abolitionists who sometimes participated in the Underground Railroad. Despite the excitement of helping slaves to freedom, the young Mr. Stevens grew bored with the family business. He wanted

action! He wanted to be in the US Navy. Captain Stevens liked to study naval tactics, to see how wits and not sheer firepower win battles. At the age of 18, he enlisted in a naval academy. He passed with flying colors and was soon placed as a cannonball loader on a gun crew. By now he worked the navy colors of blue and white. He eventually was placed on the USS Kearsarge which sank the CSS Alabama.

Remember to ask students to write with as much detail as possible in the biography.

1. As the biographies progress, ask each Northerner to select a Southerner's name from a hat containing the Southern characters. This activity pairs each Northerner with a Southerner.

2. The Northerners write their first letter to their Southern partner dated April of 1861, after the attack on Fort Sumter. The letter should discuss issues of the day in as much descriptive and colorful detail as possible.

3. Depending on the quality of the drafts, revisions to the biographies may be necessary at this point. A discussion of these revisions and why they occurred should be identified on the wiki.

4. Once the Northern letters are written, give each Northerner identical envelopes and write the name of their Southern partner. Collect the letters and act as postmaster/mistress by delivering the letters later in the day to the Southerner mailboxes. Allow the Southerners to get their mail at the end of the school day – which prolongs the mystery and excitement of the letters.

5. Select additional days from the American Civil War timeline for the letter writings and switch back and forth between Northerners writing letters to Southerners and Southerners writing letters to Northerners. Allow time to change biographies to match the situation and letter writing. Consider using the history place site located at http://www.historyplace.com/civilwar/ for background information.

6. As the letters are written, the culture of the time period should be explored. Possible activities include learning the Virginia Reel in physical education class, reading poetry and listening to the music of the Civil War era, reading historical novels in literature circles such as Michael Shaara's The Killer Angles, Julius Lester's Day of Tears, Lousia May Alcotts, Little Women or Harold Keith's Rifles for Watie. Creating maps of the time period, making connections to the present, asking questions, and writing letters bring the Civil War imaginatively alive.

7. On the last day of the lesson, students are asked to dress up as their character and bring in food of the era. Ask a teacher/colleague to read the Gettysburg Address before the feast and discuss its meaning and impact on the events of the time. [Dressing as President Lincoln makes this even more fun for students.]

8. At the end of the party, the announcement of partners is made. On learning of the partner's identity, the students should come to the front of the room and shake hands.

After the Lesson:

The Assessment for this assignment and activity needs to be creative. You and your students need to discuss the high points and low points of the Civil War and the role the students' character played in the Civil War
Discuss the social, emotional, and historical context of the day, as well asits influence on writing and literature.

Suggested assessment activities include:

Grading daily entry into the wiki of the biographical information including the addition of images, references, etc

Novel reflections from literature circles

Grading on historical research and the ability to include 19th Century detail

Assess biographies and letters by style, organization and voice
Use a rubric to assess the biography: A Sample site: http://www.middleweb.com/rubricsHG.html#anchor354383

Rubistar: http://rubistar.4teachers.org/index.php?screen=NewRubric&section_id=5#05

Fun and creativity provide the glue that binds much of what we learn to our memory. This activity involves the use of imagination with research and technology to connect students "to an understanding of voice, how history forms us, and how imagination can fire up learning in the real world" (Kloehn, 2009, p. 41)

Appendix 7

Anasazi Text

Downloadable text available at
http://prometheus.ed.csuohio.edu/edtechprimer/downloads.html

Introduction

Long before Columbus arrived in the "New World," a culture thrived in Southwestern desert where Arizona, New Mexico, Utah and Colorado meet. The region includes the Colorado and the Rio Grande Rivers, high mountain ranges, and the Grand Canyon. More people lived in this high desert area 800 years ago, than live there today. Tens of thousands of people came together to erected massive and multistoried apartment buildings, walled cities, and cliff dwellings. When the Navajo wandered into this area hundreds of years later and first saw these structures they gave a name to the vanished builders – Anasazi. In English it is translated into the "Ancient Ones."

The Anasazi developed a complex civilization of large and closely related communities. They were dedicated and successful farmers and creative workers of pottery and jewelry. They practiced a highly formalized religion, building distinctive ceremonial chambers known as kivas in which to worship. Like other ancient people, the Anasazi had a rich inner spiritual as well as sophisticated outer, material life.

Within the Ancient Ones' territory, there were three vital and distinct population centers: Chaco Canyon (in New Mexico), Mesa Verde (now a National Park in Colorado), and Kayenta (in Arizona). At Chaco Canyon, southwest of the four corners, the Anasazi built Pueblo Bonito an eight hundred room structure covering more than three acres, and reaching four and five stories high in places. To make farming possible in their desert environment, they evolved ingenious water-control devices and produced

crops to feed more people than inhabit the region now. More than 25,000 Anasazi sites have been identified in New Mexico alone. Yet, after all of this, they vanished almost within a generation. Your task, beginning today, is to find out why. Why did the Anasazi abandon their cities at the height of their civilization?

(Note, in a real Webquest you would include links to additional background information. For example - http://en.wikipedia.org/wiki/Chaco_Culture_National_Historical_Park)

Task

The Anasazi civilization lasted for a thousand years, longer than the entire history of the United States. Yet, within a generation or so a civilization that had endured a thousand years seems to have disappeared. Why?

In this webquest you will begin to understand the problem and to seek answers to the question why. In the past if you had a wanted an answer to a question such as this, you would ask your teacher, or look up the answer in a book. But for the question of the Anasazi, as with most important historical problems, there is no agreed upon answer. One book gives one answer, while a second book gives another. Many researchers have looked at this problem and each have their own opinion.

In the activity that follows, instead of asking for an answer, you will work out an answer for yourself. To say it another way, you will develop and test your own answer instead of accepting an answer someone else has developed. To help you in this work you will obtain information from web pages related to Anasazi topics.

Your task is to answer the question - Why did the Anasazi abandon their cities at the height of their civilization?

To answer this question you will:

1. generate a hypothesis – tentative guess.
2. search for data to determine the validity of your hypothesis
3. develop a conclusion about your hypothesis
4. prepare a written draft of your conclusion

Process

1. What steps do I need to follow to complete the inquiry?
2. Download the AnasaziPrep.doc file.
3. Write your hypothesis as to why you believed the Anasazi disappeared.
4. In Resources you will find links to data related to your hypotheses.
5. View several data items
6. Copy and paste data that is related to your hypothesis into the AnasaziPrep.doc file. (You will use this data to make a case for or against your hypothesis.)

Resources

(Note, in a real Webquest you would include more data resources and data for multiple student hypotheses. As a how-to exercise we list seven potential student hypotheses but only provide four data links for the hypothesis- "The Anasazi disappeared because of warfare, conflict and / or fighting." This is not sufficient data to complete the assignment.)

To simplify your search, we have organized data items by potential hypothesis. Examine the list of hypotheses and select the one that captures the key idea(s) of your hypothesis. Each data item provides information on the identified hypothesis. Note, some of the data may support your hypothesis, some of the data may refute your hypothesis, some of the

data may appear unrelated to your hypothesis. Your task is to try to make sense of the data and to account for all the data, even if it appears to disagree with your hypothesis. The goal is to test your hypothesis, not to prove your hypothesis is correct.

The Anasazi disappeared because of warfare, conflict and / or fighting.

Data Links

Cannibalism

Warfare

Trauma

MesoAmerican Influences

The Anasazi disappeared because of illness, epidemics, or degenerative diseases.

The Anasazi disappeared because of food scarcity.

The Anasazi disappeared because of significant environmental changes.

The Anasazi disappeared because of their religious beliefs and myths.

The Anasazi disappeared because of their own ecological suicide.

The Anasazi disappeared because they returned to their nomadic life.

(In a real Webquest, each of the hypotheses would include links to data resources.)

Evaluation

Anasazi Rubric

Student Name _____

CATEGORY	4- Above Standards	3- Meets Standards	2- ApproachingStandards	1- Below Standards	Score
Problem & Thesis Statement	The thesis statement names the topic of the essay and outlines the main points to be discussed	The thesis statement names the topic of the essay	The thesis statement outlines some or all of the main points to be discussed but does not name the topic.	The thesis statement does not name the topic AND does not preview what will be discussed.	
Support for Position	Includes 3 or more pieces of evidence (facts, statistics, examples, real-life experiences) that support the position statement. The writer anticipates teh reader's concerns, biases or arguments and has provided at least 1 counter-argument.	Includes 3 or more pieces of evidence (facts, statistics, examples, real-life experiences) that support the position statement.	Includes 2 pieces of evidence (facts, statistics, examples, real-life experiences) that support the position statement.	Includes 1 or fewer pieces of evidence (facts, statistics, examples, real-life experiences).	
Evidence and Examples	All of the evidence and examples are specific relevant and explanations are given that show how each piece of evidence supports the author's position.	Most of the evidence and examples are specific relevant and explanations are given that show how each piece of evidence supports the author's position.	At least one of the pieces of evidence and examples is relevant and has an explanation that shows how that piece of evidence supports the author's position.	Evidence and examples are not relevant AND/OR are not explained.	
Closing paragraph	The conclusion is strong and leaves the reader solidly understanding the writer's position. Effective restatement of the position statement begins the closing paragraph.	The conclusion is recognizable. The author's position is restated within the first two sentences of the closing paragraph.	The author's position is restated within the closing paragraph, but not near the beginning	There is no conclusion.	

Conclusion

Using any word processor prepare a draft of your answer to the question - Why did the Anasazi abandon their cities at the height of their civilization?

Include the following items

1. A statement of the problem
2. A statement of your thesis
3. References to the data that provide validation to your thesis.