Technology Institute for Music Educators

Digital Media
(Student Manual)

by Floyd Richmond, Lynn Purse, Dan Desrosiers

Floyd Richmond, editor

Copyright © 1999, 2007 Technology Institute for Music Educators

http://www.ti-me.org

These materials were made possible by a grant from NAMM (National Association of Music Merchants)
# Table of Contents

**Digital Media** ........................................................................................................... 3  
Description .................................................................................................................. 3  
Course Organization ..................................................................................................... 3  
Additional Information ................................................................................................. 3  
Hardware Requirements ............................................................................................... 4  
Software Requirements ............................................................................................... 4  
Introduction .................................................................................................................. 5  
Prerequisites .................................................................................................................. 5  
Objectives ..................................................................................................................... 5  
  Declarative Knowledge ................................................................................................. 5  
  Procedural Knowledge ................................................................................................. 5  
Assessment .................................................................................................................... 5  
Course Topics .............................................................................................................. 6  
  Topic #1 – Overview of Multimedia ........................................................................... 6  
  Topic #2 – Multimedia - Text ....................................................................................... 8  
  Topic #3 – Multimedia - Graphics ............................................................................. 14  
  Topic #4 – Multimedia - Graphics - Drawing and Painting Software ....................... 19  
  Topic #5 – Graphics Acquisition ............................................................................... 26  
  Topic #6 – Graphics - Simple Animation .................................................................... 30  
  Topic #7 – Digital Audio ............................................................................................. 35  
  Topic #8 – MIDI .......................................................................................................... 36  
  Topic #9 – Digital Video ............................................................................................. 37  
  Topic #10 – Copyright Issues ..................................................................................... 40  
  Topic #11 – Curriculum Integration .......................................................................... 41  
  Topic #12 – Individual Project .................................................................................... 42  
Student Worksheets ..................................................................................................... 43-60  

**Appendices** .............................................................................................................. 61  
Appendix 1 – Multimedia Creation Programs ............................................................. 61  
Appendix 2 – Multimedia Basics: Understanding Text .............................................. 63  
Appendix 3 – Multimedia Basics: Understanding Sound ............................................ 65  
  Digital Audio Sampling Rates and Resolutions ....................................................... 69  
  MIDI and QuickTime .................................................................................................. 70  
Appendix 4 – Multimedia Basics: Understanding Still Images ..................................... 73  
Appendix 5 – Multimedia Basics: Understanding Moving Images ............................. 78  
Appendix 6 – Blogs ....................................................................................................... 81  
Appendix 7 – Podcasts .................................................................................................. 82  
Appendix 8 – Final Cut Pro Overview ......................................................................... 84  
Appendix 9 – DVD Studio Pro Overview .................................................................... 91  
Appendix 10 – Video Glossary ..................................................................................... 94  
Appendix 11 – Suggested Schedule ............................................................................ 102
Digital Media (TI:ME 2B)
Authors 1999: Lynn Purse, Floyd Richmond
Authors 2007: Lynn Purse, Floyd Richmond, Dan Desrosiers
Floyd Richmond, editor
last updated June 8, 2007

Copyright © 1999, 2007 by the Technology Institute for Music Educators

Description

Digital Media (TI:ME 2B) covers the creation of multimedia files which may be integrated into Internet and multimedia projects, or which may stand alone as educational products (DVDs, CDs, etc.). Inservice teachers who complete this course will develop multimedia in every area including text, graphics, sound, and video. The materials developed will be appropriate for music instruction in the K-12 classroom. Software to be used in the class will include programs for creating and editing text, graphics, sound, and video. A multimedia presentation program will be used to tie elements together.

The format of the course will alternate presentations with class activities in which student progress is assessed and in which the material presented is reinforced. Evaluation will be through written homework, completion of class assignments, and the submission of a final project demonstrating techniques learned in class. This course meets one third of the coursework requirements for Level Two TI:ME Certification. Prerequisites for this course include completion of both TI:ME level 1 courses OR equivalent experience.

Additional Information

Digital Media (TI:ME 2B) may be offered as a two-credit or three-credit graduate course. Topics in ALL CAPS within the outline need not be included when it is offered for two graduate credits only. The instructor of this course must be approved by TI:ME and experienced in teaching technology to inservice music teachers. This course will serve a maximum of 16:1 teacher/student ratio. Additional students may be accommodated if additional workstations and teacher assistants are available. Each student will need approximately 20 hours working alone at a workstation in order to complete class activities and the final project.
Hardware Requirements
A computer lab/classroom consisting of up to sixteen student and one teacher's computer/music workstation is the required minimum configuration. The classroom must have the ability to connect to the Internet, with direct LAN access a plus. A telephone connection and modem at the teacher's station is also suggested (as backup for LAN network failure). Each participant must have access to a private workstation consisting of a multimedia-capable computer, MIDI keyboard, and audio and video support equipment. The teacher’s station should be connected to a projection device and all student and teaching stations should be connected to an audio playback system for class evaluation of each other's work. Hardware for creating and editing digital multimedia such as scanners, microphones, digital cameras (still pictures) and digital cameras (movies) should be available to students as needed.

Software Requirements
This course requires the following software:

- Programs for creating and editing text, graphics, sounds, and video.
- A multimedia presentation program to serve as a container for the developed multimedia files.

All software choices (or equivalent programs) should be available for Mac OS and Windows platforms. Numerous programs can be used to complete the requirements of this course. This handbook presents screen shots and explanations of techniques, which may seem to favor one program over another. TI:ME does not endorse or prefer any specific program but encourages instructors to use modern and effective software. Appendix 1 provides a list of programs for creating and editing multimedia files and for multimedia presentation.
Digital Media

Introduction
The outline is designed for a 30-hour unit on creating multimedia within a 2 credit graduate workshop. Items in UPPERCASE can be added if the course is offered for 3 graduate credits.

The primary objective of this section is to instruct students in basic skills in creating instructional multimedia. The instructor will also provide students with the information they need to plan educationally valid integration of multimedia into their teaching and legal usage of multimedia. In addition to satisfactory participation in class activities, a multimedia project is required for certification.

Prerequisites
Enrollees in this course should have at least basic computing skills at the level of word processing and familiarity with a graphic user interface (Windows or Macintosh OS). Concurrent or previous enrollment in a course on a program that incorporates multimedia files into a larger project would also be helpful.

Objectives

Declarative Knowledge
• The student describes several ways to use multimedia to enhance teaching and learning.
• The student identifies and describes copyright issues applicable to multimedia.

Procedural Knowledge
The student demonstrates basic skills in using software tools for developing multimedia for use in the classroom. The skills to be acquired include the following:

• Displaying existing multimedia files and integrating them into the teaching of music.
• Creating original multimedia files
  Text
  Graphics
  Still Pictures
  Animations
  Sound
  Digital Audio
  MIDI
  Video

Assessment
• The student completes the class worksheets on creating multimedia.
• The student creates a multimedia project useful for the classroom. The project will be evaluated in terms of its professionalism, suitability, and creativity.
Digital Media
COURSE TOPICS

Topic #1 - Overview of Multimedia

- The instructor will explain the concept of digital multimedia files, which contain text, graphics, sound, and video and will show examples of each of these multimedia files.
- The instructor will lead a discussion on how these materials may be integrated into the teaching of music.

Class Activities #1

- The student will browse media-rich Internet sites as indicated by instructor.
- The student will download multimedia of several types into a project folder.
- The student will open existing multimedia files such as pictures of instruments, composers, or recordings, which illustrate musical concepts.
- The student will explain how these materials may be integrated into the teaching of various music classes (band, orchestra, choir, general music, etc.)
- The student will complete worksheet #1 on the different types of multimedia files.

NOTES:

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________
Topic #2 - Multimedia - Text

- The instructor will demonstrate the effective use of text in multimedia documents.
- The instructor will demonstrate how to change text fonts, styles, and sizes within a multimedia presentation program.
- The instructor will explain various text file formats including TXT (ASCII), HTML, PDF, and RTF. The instructor will demonstrate how to create a PDF file.
- THE INSTRUCTOR WILL DEMONSTRATE OPTICAL CHARACTER RECOGNITION (OCR) USING A SCANNED PICTURE OF TEXT AND A TEXT RECOGNITION PROGRAM.
- The instructor will explain blogs.

Class Activities #2

- The student will enter text into a multimedia presentation program using various fonts, styles, and sizes.
- The student will save the document in various text formats (TXT, RTF, PDF, HTML).
- The student will complete worksheet #2a on the different types of text files.
- The student will create a cross-platform PDF file.
- THE STUDENT WILL CREATE GRAPHIC TEXT FILES IN THE PRESENTATION SOFTWARE USING INTERNAL TOOLS (SUCH AS WORD ART).
- THE STUDENT WILL OPEN AN HTML FILE IN A TEXT EDITOR AND COMPARE THE TEXT WITH ITS APPEARANCE IN A WEB BROWSER.
- THE STUDENT WILL CONVERT A SCANNED PICTURE OF TEXT TO A TEXT FILE USING OCR SOFTWARE.
- THE STUDENT WILL COMPLETE WORKSHEET #2b.
- The student will read the appendix on blogs.

NOTES:
Topic #2 Notes - A - Text in Multimedia

Although a picture may be worth a thousand words, written text has its place in multimedia design. In addition to titles and headings, text can present large amounts of information in recognizable sentence and paragraph formats and cost the developer very little in terms of development time and file size.

Fonts
The proper use of fonts is considered an art form in the world of professional design, the science of legibility married to the artistic development of a "look". In the digital realm, fonts can be equally effective at creating a look but are more difficult for the multimedia developer to control because of the differences in computer platforms and the lack of font control in web browsers.

Font Families
The two main families of fonts are serif and sans serif. Serif fonts are thought to be more legible in print form for the body of text, while sans serif fonts have been traditionally used in headings and titles. However, when the physical demands of reading text from a computer screen are factored in, sans serif fonts are often considered more legible when displayed on a computer screen. To see a more detailed discussion of font types, see Appendix 2.

Font Styles
As a general rule, you should limit the number of fonts used in a project to two typefaces; the overuse of a wide variety of typefaces in a single page or project can confuse the user and create a chaotic and unprofessional look. If mixing two fonts, the general rule of thumb is to use one serif and one sans serif, chosen on the basis of their visual compatibility. The careful choice of fonts can give your project the look of elegance, of whimsy, of sober seriousness, of childlike fun. Make sure that large bodies of text use a simple straightforward font; save the fancy styles for titles, headings and short statements.

Font Size, Weight, and Color
Authoring programs and HTML code all offer basic choices in size and color of font as well as bold, underline, and italic modifications. Keep your choices for font size in proportion with the overall visual look of your project but also keep your audience in mind. Young students and older users will both appreciate a slightly larger font size for reading bodies of text. Also keep in mind that underlined text suggests hyperlinks within a project or to outside sites; colored text may suggest the same thing, so use with care.

In general, limit the different colors of text to two; for more variety, use lighter and darker shades of the same color. Make sure that your text color is legible against the background field of your project; contrast in light and dark is essential for readability, so use light colored text against dark backgrounds and dark or black text against light backgrounds. You may also choose to use anti-aliasing on text to prevent jagged edges and increase the legibility of the text.

Platform Issues in Fonts
Multimedia authors must keep in mind that different fonts are standard with different computer platforms. If you are using text that is drawing on the computer’s resources, you should stick
with sans serif fonts such as Arial (Windows) and Helvetica (Macintosh), and serif fonts such as Times (Macintosh) and Times New Roman (Windows).

Different computers also translate the size of fonts differently. Due to resolution dependent operating systems. Fonts may appear larger or smaller on different screens; this difference can throw off a carefully designed screen, so build some flexibility into your design to accommodate this difference if you are developing for both platforms.

One way around the lack of control over fonts is to embed the fonts of your choice within the multimedia project itself (possible in most multimedia authoring software). In other words, you can embed a font type(s) or package it with your project so that it can be drawn on when it runs the program. You may have experienced the need to load certain fonts into your computer before watching a multimedia CD-ROM; these are included on the CD-ROM with directions for their installation. Providing fonts increases the chance that your viewer will see the project as was originally intended.

You can also create text as a graphic object in a paint or photo editing software package; this is an excellent way to create titles and headings that draw on more decorative fonts to create a special look. Fonts for music notation can also be used to create graphic objects. For browser integration, Cascading Style Sheets (CSS) are a way to improve the overall look of your web site. A CSS document located in the same directory as your HTML file (and referenced to within the HTML file) provides a list of rules that all the pages will follow.
Topic #2 Notes - B: Capturing and Delivering Text

Opening Existing Text Files
Most authoring programs and HTML editors allow you to open existing text files and convert them to usable text material. Plain text files (TXT) contain only alphabetic characters, numerals, and a few symbols. These files do not contain any formatting (underline, bold, italics, tab settings, margins, etc.) Plain text files are created using programs such as Notepad (Windows) and TextEdit (Macintosh). Rich Text Files (RTF) contain formatting instructions and can be read by many multimedia programs. When text is formatted using a word processor, it is frequently possible to preserve that formatting by saving it as an RTF file.

Scanning Text
Optical Character Readers (OCR) are software programs frequently packaged with scanners that allow the user to scan printed text and interpret it as editable text rather than graphic symbols. OCR programs that allow you to preview the scanned material and make corrections before converting the files to text are preferred, especially if they can recognize columns and formatting of printed material effectively. Generally, the scanned file is then opened in a word processing program and reformatted and corrected as desired. Large amounts of printed text can be scanned and saved in this manner.

PDF Files
Portable Document Format (PDF) files appear the same on different machines running different software. PDF files are a superior method of file exchange, maintaining the look of both printed text and graphics, something not possible with Rich Text Format (RTF) or other text files. Adobe® Acrobat® has become the software package of choice for creating PDF files, partly because their Acrobat® Reader program is free and readily available from their web site. The Acrobat® PDF Writer software, available for purchase, enables any print-capable program to create PDF files. Acrobat® can also “distill” EPS files (files with page layout instructions for laser printers) into PDF files. Because EPS files are easily created using notation software and some people have many of these files on hand, Acrobat® is a frequently used to convert them. See the pages below for more information on PDF files.

Converting Text Files
Plain text (ASCII) files may generally be opened by any word processing application. Other files such as PDF, RTF, DOC, may sometimes be opened and edited only by the application that created them. In most cases, it is possible to copy and paste text from one application to another, but sometimes formatting (bold or italic character formatting, paragraph orientation, etc.) is lost in the process. You may have re-enter formatting, especially for small documents. It is often worthwhile to experiment with several approaches when converting text from one format to another. For example, an RTF document may open in a simple word processor with text formatting intact. When copying and pasting the text into a web editor, the formatting may be lost. If the web editor can import RTF files, or if the word processor can export web (HTML) files, the formatting may be preserved.
Topic #2 Notes - C: PDF Files

HTML files and their variations are a common format for text and graphics on the Internet. This powerful format permits the easy combination of multimedia into an arrangement that will display on a variety of computer devices with monitors of different sizes. One shortcoming, however, becomes apparent when those files are printed. Almost every browser sends a different version to the printer. These printed versions contain graphics, which are positioned differently on the page, and line, and page breaks which occur at different spots in the document. An instruction such as “see paragraph 2 of page 4” might point to different text on every printed copy. One might think that documents formatted for common word processors would little better results. The problem here, though, is that fonts used in the original document are seldom found on the computer of the person viewing or printing the document. Again, pages could break at different points and text which explains graphics and figures may not be located in the vicinity of the object to which it refers.

What is needed then, is a consistent format for printing documents that permits exact placement of text and graphics on the page, the exact placement of line and page breaks, and the incorporation of the same fonts used in the original document. Portable Document Format (PDF) files address these needs, and more besides.

The PDF format was initially created by Adobe Systems Incorporated, who released a program (Acrobat®) for creating them and distributed a free reader (Acrobat® Reader) for viewing them. These caught on with such popularity that PDF readers are now incorporated into the operating system of many computers. Modern Web browsers, through plug-ins or helper applications display PDF files directly in a browser window. Those with older computers can still download the Acrobat® Reader (http://www.adobe.com).

PDF files are a necessity for creating tutorials with references to past and upcoming sections, creating worksheets for students, or placing music on the web that consistently prints the same. How then do we create PDF files? On Macintosh and Windows computers the process can vary so an explanation for each will follow:

Macintosh

From the application that you have used to format the document exactly as you want it, go to the “File” menu and choose “Print.” Next, click the “Save As PDF…” button at the bottom of the window and indicate where the file is to be saved.
Windows
You will need to download a software program such as PDFWriter, which converts various documents to PDF format. A number of these are available for free on the web. Follow the instructions of the particular tool you download or purchase.

Windows and Macintosh (Basic and Advanced PDF operations)

**Basic Operations**
You will need a copy of Adobe® Acrobat®. Fortunately, the educational discount for this product is quite affordable. Once Acrobat® is properly installed, from the application that you have used to format the document exactly as you want it, go to the “File” menu and choose “Print.” Next, set the printer to AdobePDF, and then choose “Print”. The computer will prompt you for a location where the file is to be saved.

**Advanced Acrobat® Operations**
For Windows or Macintosh users interested in password protecting documents (as you might with content that you sell online), or in creating forms which students might complete by typing (as you might with a test distributed online), you will need a full version of Adobe® Acrobat®. The next section of this article will give the steps for adding these features to PDF documents.

**Password Protecting a PDF Document**
For this you must have previously created a PDF file (using any method above) and have a copy of Adobe® Acrobat® 5 or greater. The following steps will add a password:

- Run Adobe® Acrobat® and from the file menu, choose, “Document Security...”
- From the “Security Options” tab, select “Acrobat Standard Security”
- Check the box labeled “Password required to open the document.”
- In the field below, type the password. Make a note of this password. Without it, you cannot open the PDF file!
- NOTE: you may want to set the level of the security based on your potential audience. Adobe® Acrobat® Reader 4.0 and earlier only supports 40-bit encryption of passwords. Versions 5.0 and higher support 128-bit encryption.
- NOTE: You may also use this dialog box to set whether the person viewing the document may change it, print it, etc. This will require a different password. Again, make a note of it. Without the passwords, you cannot perform the functions that are protected.
Creating a PDF form to be completed and printed by the user

First you will create a PDF file, which will contain the form, using any method above. You may need to give some thought to leaving space where buttons and text fields will eventually appear. Next, you’ll use Acrobat® to open the document and insert the form elements. The following steps explain this process.

- Run Adobe® Acrobat® and open the Forms Toolbar (Tools>Forms>Show Forms Toolbar)
- The forms toolbar contains tools for creating text fields, checkboxes, radio buttons, etc. Click the tool that you wish to use (Text Field, for example).
- Drag a box around the area where the form element should appear. If you have a place in the document where users are to enter their name, for example, you may create a text field in that area.
- A dialog box will appear with options for the form element. If you are inserting a text field, options might include whether the field includes scroll bars, multiple lines of text, and whether the text can be formatted (bold, italics, etc.).
- When you’ve finished entering the form elements into the document save and test it.

You can combine features such as password protection and form elements. You can also use Acrobat® options to control other options such as whether the document uses high or low-resolution graphics and whether it embeds fonts or not.
Topic #3 - Multimedia - Graphics

- The instructor will demonstrate how to add existing graphics to a multimedia presentation program.
- The instructor will present an overview of techniques for creating and editing graphic images such as using drawing software, scanning images, and taking digital photographs.
- The instructor will present a discussion of the advantages and disadvantages of various graphic file formats (GIF, JPG, PNG, BMP, PICT, TIFF, etc.)

Class Activities #3

- The student will add existing graphics of three or more kinds into a multimedia presentation program.
- The student will complete worksheet #3.
- STUDENT’S WILL INSERT THE SAME GRAPHIC OBJECTS INTO AN HTML DOCUMENT.

NOTES:

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
**Topic #3 Notes: Multimedia Graphics**

Preparing graphics effectively can bring a powerful visual element to multimedia projects and web sites while keeping file sizes small and enabling graphics to load quickly. Graphics can serve as the focal point of a screen presentation, as part of a background image, or as a navigation symbol.

All graphics that are designed to be viewed primarily on computer screens have two things in common, due to their display on a standard monitor: All color files exist in or are converted to RGB (Red Green Blue) color space, and all bitmapped images have a resolution of 72 ppi (pixels per inch).

**File formats**

A variety of file formats exist for graphics; most multimedia authoring and presentation programs recognize all or most of the file formats, while web browsers recognize only compressed files (JPG, GIF, animated GIF). Web browsers equipped with readily available plug-ins also recognize Flash animations.

- **TIFF** (*Tagged Image File Format*) A widely used and versatile bitmapped file format which can be imported into many different types of applications, and works for all types of images, including color and grayscale with varying bit resolution.
- **PICT** (short for *Picture*) A Macintosh format used for screen display or printing.
- **BMP** (short for *Bitmap*) A Windows format used for screen display or printing.
- **EPS** (*Encapsulated PostScript*) A format for saving images, which will be sent to laser printers, or converted to PDF files. The downside is large file sizes and less than excellent appearance on computer monitors. Also, many programs cannot import or display them.
- **JPEG** (*Joint Photographic Experts Group*) The most popular format for distribution of images today, JPEG uses a lossy compression scheme to keep file sizes down, with varying degrees of quality. JPEG format supports subtle tonal changes in 24-bit color (millions of colors).
- **GIF** (*Graphic Interchange Format*) An 8 bit (256 colors) palette-based file format primarily used for displaying graphic images with limited color information
  - *Transparent GIF* (GIF87A) GIF files that support transparency and interlacing, used to create the illusion of irregularly shaped graphics and “floating” text
  - *Animated GIF* (GIF89A) Animated GIF files that also support transparency and interlacing, made up of a small number of GIFs combined to create a simple repetitive slide show that appears to be an animation
- **SWF** (*Flash Animation*) The only form of vector graphics that is supported on the web, Flash animations are notable for their sophisticated movements and visual size while remaining small in file size.
- **PNG** (*Portable Network Graphics*) A high compression file format designed especially for web use that uses lossless compression and can be stored at many different bit levels. PNG format support is integrated into the Mac OS X architecture, while Windows support is less than optimal.
• PSD (Photoshop®) A format for files created and saved using Adobe® Photoshop® which uses zero compression, and is recognized by other programs such as Fractal Design Painter and other Adobe® products. PSD files may also be opened directly within OS X using Preview.

Raster and Vector Types
Raster graphics are analogous to bitmapped image files such as TIFF, JPEG, GIF, etc. The information in the file is stored as a series of values in a pixel format and is well suited to photographs and graphic images. These are created or saved in a raster graphics program such as Photoshop®, ImageReady® (discontinued after CS2), or other photo editing and multimedia authoring software.

Vector graphics are stored as mathematical points, allowing them to be easily resized without a loss of image quality and with no concurrent change in relative file size. Line drawings, illustrations, and type are well served by these programs. Software such as Adobe® Illustrator®, Corel® Draw, and Adobe® FreeHand® are well-known vector based programs.

Resolution
Graphics created for display on computer screens are always saved with a resolution of 72 dpi, the universal resolution rate of on-screen graphics, however, not all screens display at that resolution anymore. With the influx of high-resolution screens in standard form factors, as well as hand held devices, the accepted standard is becoming less of a concrete number. Most displays being manufactured today will display at around 100ppi.

When preparing files to be printed, it is important to remember that print resolution differs from screen resolution. A print-ready document should be created at 300dpi for a professional look. A document printed at 72dpi will have very jagged edges and have an overall unacceptable look. The most important thing to remember, however, is not necessarily the resolution per se, but the actual pixel count in the document.

The common point to remember is that all graphics displayed on a computer screen should be measured in pixels rather than inches. Documents for print are measured in inches, but the digital document still may be measured in pixels. A graphic that is 1”x1” at 300dpi is 300 pixels, square. A graphic that is 300px x 300px at 72dpi is about 4.17”, square. Though they can contain the same amount of information, the printed 72dpi image will appear jagged, much like a picture blown up to almost 400% of it’s original size.

File Size
Graphic files for printing can be huge, up to 1GB and beyond. Graphic files for multimedia are much smaller and may also be compressed for a further reduction in file size, which is particularly important for Internet delivery. Ideally, the total size of a single web page is no more than a few hundred kilobytes (KB); graphics can add unnecessary weight to web pages. There is a direct relationship between file size and file quality.
Compression of Graphic Files
Lossy compression offers excellent image compression, the benefit being small file size, but results in some permanent loss of data (color depth, edge clarity, etc.). JPEG images use a lossy compression scheme; therefore compression should take place only after all editing of the image is complete. Opening and editing a file that has already been compressed as a JPEG, then re-compressing it will result in further loss of data. If possible, keep the original source file and return to it to make further edits.

Color Mode
The format for all digital images containing color should be RGB, reflecting the three primary wavelengths of light (Red/Green/Blue); CMYK (Cyan/Magenta/Yellow/Black) is designed to address color separations for professional print shops and should be avoided for images destined for computer display. In general, all color photographs should be created and saved as RGB files; black and white photos can be saved as grayscale but must be changed to RGB if colorization is desired. Simple graphic files can be reduced in size by changing their mode from RGB to Indexed Color, and then exported as GIF files.
Sources of Multimedia Graphics

Scanning
Flatbed scanners are an inexpensive way to acquire images, and also often have photo editing software bundled with them. Slide scanners tend to be far more expensive and designed for the professional user; some flatbed scanners now include the ability to scan slides, transparencies and negatives, a very useful feature.

Download from Web
Royalty-free images, everything from photos to background graphics, can be easily downloaded from the Internet (control-click with the mouse on a Mac, right mouse click on Windows). Because these images are already compressed, they should be used “as is” if possible. JPEGs are particularly prone to image quality loss if opened and edited. It is important to note, however, that just because an image is found on the Internet does not mean that it is royalty-free. You should always check with the copyright holder of the image you are referencing before using it for your own work.

CD-ROM Clip Art
CD-ROMs containing royalty-free clip art can be purchased for varying prices; these often contain high quality professional photographs and illustrations in specialty areas, such as musical instruments and arts performances.

Photo CD
If you have a large number of transparencies or negatives to be scanned, investigate having a Photo CD made of your materials. You will have a permanent source of material professionally scanned at varying resolutions; many pharmacies (CVS, Walgreen’s, Eckerd) will perform this service on site, while some local camera shops send these materials to Kodak for processing.

Digital Cameras
Digital cameras continue to improve in quality and features and offer the convenience of bypassing the film processing and scanning tasks and allow you to load digital images directly into a computer for processing. However, most cameras compress the images into JPEGs when storing to disk or card, guaranteeing some loss of image quality if it needs to be edited in any way. Digital cameras are most useful for point and click shooting; only the more expensive digital SLR cameras offer the light and aperture controls as well as a choice of lenses normal in a 35mm camera.

Video Capture and Still Screen Capture
Capturing video and still shots from an analog video source are non-mainstream alternate ways of acquiring digital images, provided you have a video player and a computer with analog video inputs. To begin, connect the video output to the computer’s video input. Most machines will require a video capture card, which may include software to capture both video and still images.

Digital video cameras and playback equipment will plug directly into a computer via a FireWire interface and interact with existing software such as Apple iMovie or Windows Movie Maker. These programs make it easy to capture still frames or video from a digital camera.
Computer Screen Capture:
Especially useful when demonstrating computer techniques or software features or designing sites for a particular web browser. On the Mac, Command-Shift-3 will create a snapshot of the entire screen and store it as a PNG file on the computer’s Desktop. Windows machines will load a BMP image in the computer’s clipboard when the Print Screen key is pressed. See the overview below for additional information.

<table>
<thead>
<tr>
<th>MACINTOSH SCREEN CAPTURE AT A GLANCE</th>
<th>WINDOWS SCREEN CAPTURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Command-Shift-3</td>
<td>Print Screen</td>
</tr>
<tr>
<td>Save the screen to a file on the computer’s desktop entitled Picture 1, Picture 2, etc.</td>
<td>Save the screen to the computer’s clipboard.</td>
</tr>
<tr>
<td>Command-Control-Shift-3</td>
<td>Alt-Print Screen</td>
</tr>
<tr>
<td>Save the screen to the computer’s clipboard.</td>
<td>Save the front-most window to the computer’s clipboard.</td>
</tr>
<tr>
<td>Command-Shift-4</td>
<td>When using Windows (or Macintosh options which place the image on the computer’s clipboard), the image must be pasted into a graphics application or word processor to be used, or saved. This should be done before anything else is copied to or captured to the clipboard.</td>
</tr>
<tr>
<td>Permit the user to select by dragging the area of the screen to be saved to a file.</td>
<td>Windows users running Vista may use its Snipping application to capture screens or parts of the screen. Run the application, drag a box around what you want, and then save the image that appears.</td>
</tr>
<tr>
<td>Command-Control-Shift-4</td>
<td></td>
</tr>
<tr>
<td>Permit the user to select by dragging the area of the screen to be saved to the computer’s clipboard.</td>
<td></td>
</tr>
<tr>
<td>Macintosh users running OSX may use its Grab application to capture screens, windows, parts of screens, and even the cursor. Run Grab, (Applications&gt;Utilities&gt;Grab) and then choose the desired option from the Capture menu. The computer then provides prompts to complete the process. Be sure to save any images you wish to keep for later use.</td>
<td></td>
</tr>
<tr>
<td>Photo and Graphic Art Software:</td>
<td></td>
</tr>
<tr>
<td>A wide variety of software exists allowing the user to edit photos, paint, and draw, creating a broad spectrum of original art. Software can be classified as either raster or vector-based editing.</td>
<td></td>
</tr>
</tbody>
</table>

**Inserting Graphics into Multimedia**
Generally, inserting graphics is a fairly simple procedure, accomplished by either importing a file or an internal insert command.

- Presentation Software such as Microsoft PowerPoint uses Insert>Clip Art>From File to insert photos and graphics, where they then can be positioned the same as any other object.
  - To insert a background graphic as a repeated pattern, the equivalent to tiling on a web page, locate the background/fill commands in your software and choose the texture fill. (In PowerPoint, choose Format>Background>pull down menu to Fill Effects>Texture>select your background graphic file>Apply)
  - To insert a photo image or graphic logo as a background choose Format>Background>pull down menu to Fill Effects>Picture>select your background graphic file>Apply

- Multimedia Authoring programs frequently contains painting tools for internal creation of graphics and requires that all graphics created externally be imported. Some programs allow the user to import a picture to be used as a background.

Web pages require the appropriate HTML coding to display graphic objects. Many web page editors such as Adobe® Dreamweaver® and GoLive®, however, permit drag and drop positioning of graphics.
Topic #4 - Multimedia - Graphics - Drawing and Painting Software

- The instructor will demonstrate how to edit existing graphics using a drawing and painting program.
- The instructor will demonstrate importing or converting the graphic, cropping the picture, changing the brightness and color balance, converting to black and white, resizing the picture, and saving or exporting the image.
- The instructor will explain the difference between vector based graphics and bitmapped graphics.
- The instructor will demonstrate the drawing and painting program’s tool set with special attention to drawing lines, shapes, and text; selecting, copying, and pasting parts of the picture, and adding backgrounds and/or textures.

Class Activities #4

- The student will resize and crop an existing image and correct color and contrast.
- The student will open and correct color and brightness settings in a photograph.
- The student will convert a color picture to grayscale or black and white.
- THE STUDENT WILL CREATE AND SAVE A BACKGROUND IMAGE FROM A PHOTOGRAPH, APPLYING OPACITY AND CONTRAST TECHNIQUES AND SAVE AS A JPEG FILE.
- The student will open a paint program and experiment with the tool palette, including paint brushes, lines, colors, textures, and filled shapes.
- The student will create several objects, including filled and linear shapes as well as freeform sketches and save them as individual image files.
- The student will save or convert work to an appropriate graphic file.
- The student will complete worksheet #4.

NOTES:
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
**Topic #4 Notes - A: Paint and Draw**

**Bitmapped and Vector Graphics**
Bitmapped images are made up of pixels, which permit subtle gradations of tone and color but limit the ability to make existing graphics larger without significant degradation of image quality. Familiar bitmapped file formats include TIFF, BMP, PICT, JPEG, and GIF. Most graphic paint and photo editing programs are bitmap-(also called “raster”) based programs. Popular raster-based image manipulation programs include Adobe® Photoshop®, Jasc Paint Shop Pro, and the open-source alternative, GIMP (GNU Image Manipulation Program). Vector images use lines and curves, based on points, that form shapes based on mathematical instructions; this allows the shapes to be resized easily without affecting graphic quality and also keeps file sizes very small. Most drawing programs are vector based, the most popular including Adobe® Illustrator® and FreeHand®.

Most multimedia authoring and presentation programs also include paint and draw capabilities within themselves, and there are a multitude of shareware paint programs.

Unless a layer feature is included, basic paint programs tend to be difficult to edit as the most recent additions of pixels replace anything that they overlap. Creating a pixel based graphic can demand careful attention to detail and liberal use of the Undo Command. A sophisticated program like Adobe® Photoshop® allows the user to work in separate layers, giving more editing control than is usual.

**The Tool Palettes**
Most paint and draw programs contain a basic common tool palette that includes painting, shape, color fill, and selection tools.

**Paint Brush**
The most common tool of the palette, brushes can be chosen for size and shape as well as color and pattern. The user can paint with solid colors or with a selected pattern such as bricks or herringbones.

**Airbrush**
Analogous to an artist’s brush driven by compressed air, the airbrush tool is capable of creating soft lines and areas in colors. A graphic pen table can provide pressure sensitivity to airbrush and other tools.

**Pencil/Pen**
The pen or pencil tool is usually a one pixel wide drawing tool, useful for drawing irregular lines, and may usually be assigned a color.

**Line/Arc**
Lines and arcs draw straight or curved lines between points; the line width can be determined by pixel size. Colors can be applied to line and arc tools.
Shapes
Shapes, both filled and empty, are exceptionally useful. The ellipse shape will create ovals, and circles when constrained by key commands. Rectangles can be constrained to squares, and polygon shapes are irregular shapes created by clicking on points and dragging between. Unfilled shapes leave the enclosed areas in the graphics transparent. These areas can be filled with the paint bucket tool, using colors or patterns.

Text
Text can be placed into paint programs but once it is on the screen, it is a graphic image and usually can’t edited for font style, size, color, etc. If your paint program is capable of layers, text may be placed on a separate layer, and remains a vector unless it is rasterized.

Color
Graphic images are limited to a 256-color palette (8-bit). Graphics destined for use on the web should be limited to the web palette, which contains only 216 web safe colors. Web safe color palettes are now included or can be imported into many graphic editing programs; ignoring the web palette means risking graphics which do not display well in web browsers and across computer platforms. Web color safe palettes can be downloaded for free from Lynda Weinman’s web site at www.lynda.com.

Editing Bitmapped Graphics
Generally, editing bitmapped graphics takes practice because it means erasing existing pixels or laying alternate images over those areas. Bitmapped images can be resized to be smaller but become distorted if resized to be larger. Create and edit carefully and use the Undo Command liberally. Many graphic programs are a combination of both paint and draw features; exploring the tools of a particular program will indicate which tools are raster based and which ones are vector based.

Although TI:ME does not advocate any one software package, it should be noted here that Adobe® Photoshop®, while intended primarily as photo editing software, contains sophisticated paint tools and through the use of unlimited layers can be used as a powerful paint program. It also has the advantage of combining graphics and photos together into hybrid images and includes powerful special effects tools, all of which can be exported into a variety of file formats. An excellent book on this subject is “Fine Art Photoshop: Lessons in Digital Drawing” by Michael J. Nolan and Renee LeWinter, Hayden Books, 1997.

Exporting Graphics as GIF Files
GIF files (Graphic Interchange Format) use an 8-bit (256 colors) palette-based file format particularly suited for displaying graphic images with limited color information. Preparing graphic files for export into a GIF format usually involves changing the image mode to indexed color, then following the software’s steps for exporting as a GIF file. Indexing a color palette makes for extremely small file sizes. GIF compression is lossless; so no color information is lost through the compression process and unlike JPEG’s, GIFs do not need to decompress to open, making them slightly faster to view. However, color information is limited to 256 colors (216 in a web palette), making the GIF format suitable only for graphics with a limited color range.
Transparent GIF Files
GIF87A files support transparent and interlaced images. When exporting a GIF file, a window may be provided previewing the image and is equipped with an eyedropper to “sample” the background color that the transparency format will ignore; in more professional programs, any transparency used will automatically be included. Transparent GIF files are used to create the illusion of irregularly shaped graphics and text “floating” over a background. Keep in mind that GIFs intended for transparency should be created over the same background color that will be used in the multimedia project or web page. This will reduce the white pixel ghosting around a transparent image that is often apparent in transparent GIFs.

Interlacing is a selection in the GIF exporting process that allows the GIF image to “build” onscreen when opened in a browser, giving a rough view of the graphic as it loads.

Vector Graphics
Vector based graphic programs tend to be drawing rather than painting software. Because the graphic elements in vector programs are easily resized to both larger and smaller images without a loss in quality, they are particularly suitable for creating complex drawings and linear graphics as well as manipulating text into moving paths. Some software packages such as Adobe® Illustrator® allow bitmapped graphics to be imported into the vector program for resizing and editing.

The disadvantage of vector graphics is that they are not recognized in many multimedia programs and are not part of the web browser standard. In order to be useful for the web, vector graphics must be exported into a raster based program and saved to a recognized bitmap file format. At this point, vector graphics are subject to the same limitations as bitmapped graphics.

Vector graphics, however, do have validity in a multitude of situations. Many professional print shops will require the submission of vector-based files to print promotional items, tee shirts, case tags, and the like. Logos are often designed simply as vectors, to allow maximum scaling, then may be rasterized and imported into a raster graphics program to add effects.

Because vector graphics are based on mathematical points, not millions of pixels, vector files can be much smaller than their raster counterparts; whereas a print-quality 300dpi image could weigh in at over 100MB, the same vector file could be as small as a few hundred kilobytes. This makes vector images much easier to send as an attachment in an email, with a high-quality result. Again, vector graphics are not recognized in many non-professional multimedia programs, but their proper use is invaluable in many situations.
Topic #4 Notes - B: Photo Editing

Photographs in Multimedia
Even in musical presentations, photographs are a major part of a multimedia design. In addition to featuring important images, such as a photo of an ensemble or a violin bowing technique, photographs are also used as background images and for navigation objects such as buttons, arrows, and hyperlink metaphors.

Photographs in digital form are bitmapped objects and must be sized properly for final use. Photographs in multimedia and presentation software may be used in a variety of formats, both compressed and uncompressed. Photographs in web pages are always compressed, usually in JPEG format to preserve color detail and tonal gradation. Photos may also be compressed as GIFs, especially when used as thumbnail sketches and hyperlinked objects.

Editing Photographs
Most photo editing software, whether a simple “Lite” or “Elements” package bundled with a printer or scanner or a robust professional program, can perform certain basic tasks essential to preparing photographs for multimedia use.

Importing files
Launch the photo editing software and use the Open or Import command to open any graphic image file, whether TIFF, JPEG, GIF, PICT or BMP. Before you begin editing, always duplicate the original background layer, keeping it as source material, so you will always have something to go back to.

Retaining Source Material
If possible, all digital images should be saved in layered TIFF or Photoshop® native formats. When compressing images for various uses, be sure not to replace the source image: save the various edited files with the appropriate extensions (.jpg or .gif) and return to the source file rather than a compressed file for further editing.

Editing Files

Resolution and File Size
All images intended for display on a computer monitor should be reduced to 72 dpi; any images that are also meant to serve as print material, such as cover art for a CD, should be preserved as a source file at 300dpi. The final size of the computer monitor should be taken into consideration when determining the image size. Digital image size is measured by pixels, not by inches. An image measuring 1024 x 768 pixels could entirely fill a 15” computer monitor, so size your images accordingly. Image size and quality is directly related to file size; a smaller image compressed at a good to better quality will load faster and look better than a large image compressed to a low quality.

Cropping
Tight cropping of an image will increase its visual impact and focus the viewer’s eye on the main subject. Before resizing your image, crop all unnecessary areas of the image for the most
pleasing composition. Composition rules such as the “rule of thirds” offer suggestions to make your subjects become the focus of your images.

**Adjusting Image Levels**
After the image has been cropped and sized, the most important step in preparing a digital image is to adjust the overall levels of the image, if the software permits. This is the visual equivalent of eliminating dead space filled with noise in an audio recording. Look for controls for adjusting levels or tonal curves; in Photoshop®, this is accessed via Image > Adjustments > Levels. A histogram appears (a visual representation of each brightness value in your image, 0-255: it looks like a graphic equalizer, showing levels from bass to treble); any empty areas at either end of the graph can be eliminated by dragging the outer arrows to the beginning of the black areas in the graph, thereby enhancing the highs and lows of the image. The midtone slider can also be moved to the left or the right to enhance contrast.

**Image Mode**
All color images should be in RGB mode during the editing process. Black and white photographs can be in grayscale mode; however, black and white photographs can have color added to them if the mode remains in RGB, and changing their mode to grayscale can change color photographs to black and white images. Indexed color mode is used when preparing a graphic for export as a GIF file; this reduces the color information in an image with an accompanying reduction in file size.

**Color Balance**
Color balance is a general control, permitting the shifting of color balances in an image. Color photographs that are too blue or red can be easily corrected here. Color balance can be applied to the three tonal areas of the image: highlights, midtones, and shadows. Checking the “Preserve Luminosity” box will allow your image brightness and contrast to remain constant while you correct color.

**Hue & Saturation**
Hue and Saturation is yet another way to adjust the overall color of your image. Hue refers to the red/blue/green color channels; fine-tuned adjustments as well as extreme color shifts for interesting affects can be made to the Master RGB channel or a single color channel. To create an old-fashioned sepia tone look, check the “Colorize” box, and move the Hue slider to 42. Saturation refers to the intensity of a color; editing the color saturation of an image can result in a black and white image or a vibrant over saturation of color. Lightness controls adjust the overall lightness of the image to varying degrees; this control can be used to create pale low contrast images suitable for backgrounds.

**Brightness and Contrast**
A more primitive way to apply levels, brightness controls affect the overall brightness or darkness of an image while contrast controls affect the relationship of brightness and darkness in an image. Users should stay away from this control box, instead using the more advanced Levels or Curves controls.
Filters and Effects, Plug-ins
Filters and effects are useful in the final editing stage for “finishing” a photographic image. Sharpening an image increases the contrast between pixels and gives the effect of sharpening the focus; be careful not to overdo this effect. Special effects filters range from blurs to artistic paintbrush effects, depending on the software. Professional software such as Photoshop® also have provisions for plug-in filters developed by third party companies, providing special distortion or edging effects not included in the original software.

For a professional look, you will seldom apply filters to the entire image. Though it is tempting to do so, try to stay away from making your entire image look like a colored pencil or charcoal drawing. Instead, try using a Layer Masking technique to selectively apply filters to only the portions of your image you want to effect.

Layers
Multiple layers are always a feature of professional image editing software, enhancing the creation of collages and sophisticated images. Layered images must be flattened before they can be compressed, which is automatically done when you save as a compressed image format. Always keep an original, layered copy of your image on hand, in case you need to edit the image later.

Image Compression
Compression of an image is the last step in preparing photographs for multimedia. Many authoring and presentation programs do not require compressed images, but often will accept them. Images on the web must be compressed in order to be read by a web browser. A description of JPEG and GIF compression formats can be found in Appendix 4 Multimedia Graphics.
Topic #5 - Graphics Acquisition

- The instructor will demonstrate the process for scanning a picture and saving or converting it to an appropriate graphic file. Scanning to match the screen size, resolution and color depth will be explained.
- The instructor will demonstrate the process for using a digital camera to capture images.
- The instructor will demonstrate the process for downloading and converting the images to an appropriate format.

Class Activities #5

- Students will scan a photograph of their choosing (preferably of themselves, perhaps from a photo ID) and will save the scan and convert the file to an appropriate file format.
- The student will complete worksheet #5a.
- Students will take pictures of each other using a digital camera. Students will download the photographs from their camera to the computer. Students will complete worksheet #5b.

NOTES:

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
**Topic #5 Notes: Capturing Digital Images**

The instructor will demonstrate the various techniques of capturing digital images, including scanning, digital cameras, capturing stills from video and importing a variety of file formats into image editing software.

**Scanning**

**Scanners**
A scanner is a device that optically reads or “scans” material one line at a time, storing it as digital information. A camera-like device, a scanner moves across an object placed on a “bed” and measures the registered image as pixels in its X and Y coordinates, creating a “sample” of an image. A light source moves with the scanner to provide optimum exposure of the image to be captured. Flat bed scanners are perhaps the most familiar type of scanners and generally are equipped with a flat glass plate and a lid that provides a white background for the scanned item. Inexpensive and moderately priced flatbed scanners that capture good quality images and text are increasingly available. Some scanners will also scan transparencies (slides); while this is a useful feature for a multi-purpose scanner, the best results in scanning slides and negatives are achieved with a dedicated slide scanner.

**Scanning Software**
Scanners are packaged with appropriate computer software, allowing the computer and scanner to communicate appropriately when capturing and storing images. Photo editing software is often bundled with a scanner, allowing the direct import of scanned images into the photo editing software format, saving time and image storage space.

**Scanning Techniques**

**Preview**
A preview scan allows a quick scanned version of the image, allowing the user to correct problems or reposition the original. A marquee box for cropping the image usually appears at this point.

**Cropping**
Always take advantage of cropping the previewed image before final scanning. This permits the user to choose the size and shape of the scanned image, excluding extraneous material and increasing the scanner’s ability to measure the tonal area of the scan. Cropped images also reduce file size.

**Input Mode**
Although some scanners provide an “automatic” mode selection, the user will get better results choosing the correct mode for a scan based on the source material.

- **Line Art** (1 bit or bitmapped) – Choose this mode for pure black and white originals, including line drawings and text.
• **Halftone** (dithered) – Used primarily for scanning photographs to be printed on black and white laser printers. Generally not appropriate for use in multimedia graphics.
• **Grayscale** (8 bit) – The best mode for scanning black and white photographs and artwork, it produces 256 shades of gray for excellent tonal gradations.
• **Color** (24 bit) – The best mode for scanning color photographs, transparencies, and artwork, it provides 256 variations of each RGB color. It also creates the largest file sizes.

**Resolution**
For permanently archiving digital images or for print output, scan at 300 to 600 dpi. However, for images destined for computer screen output, scanning between 72 and 150 dpi will reduce scan time as well as file sizes and will provide acceptable scans for multimedia purposes. Slides and small objects should be scanned at higher resolutions, as their smaller image size will need to be enlarged at the editing stage to provide appropriately sized images.

**Tonal and lightness controls**
Although scanner software often provides tonal and lightness controls, it is generally preferable to avoid using these, unless it is impossible to capture the image otherwise. An example would be a very dark image with shadows hiding important detail; adjusting the scanner’s lightness control may provide enough detail to make the image usable. Otherwise, importing the scanned image into third-party software provides more effective control in this area.

**Descreening**
Published materials go through a screening process before printing; scanning a published image will result in a fine “screen” appearing on the image. A descreening control will remove this in the scanning process, an extremely useful feature if available.

**Saving Scanned Images**
All scanned images should be saved as a source file, either a TIFF image or a Photoshop® file if directly imported into that program. Any compressed formats should be saved IN ADDITION to the source image, so that later edits can be made easily. An image that is to be used in a variety of ways is best scanned at a high resolution, particularly if a printed version will be used for labels, flyers, etc.

Digital images can take up a significant amount of storage space; always back up your work! External hard drives are a useful, accessible way to have your work on hand, but not taking up valuable space on your main drive. CD-Rs and DVD-R and -RWs are also great, distributable media to have your digital images stored on.

**Scanning Small Objects**
Small objects such as guitar picks, woodwind reeds, buttons, leaves, etc. can be effectively scanned on a flatbed scanner. Extreme care must be taken not to scratch the glass surface of the scan bed; the safest course is to cover the glass surface with clear plastic (transparencies) or glassine sheets (available at art supply stores). Use a glass surface cleaner to keep the glass scanner bed spotless.
Digital Cameras
Most digital cameras offer a convenient way to capture images quickly and import them directly into a computer, bypassing the film processing stage. In-camera image control features are improving rapidly, as are pixel resolution rates.

However, most digital cameras store the images into a disk or card format by compressing the images into JPEGs when storing to disk or card. Compressing images always results in some loss of quality. To obtain photographs that are consistently the most useful possible, always shoot in the highest quality your camera will allow. Most prosumer digital SLR cameras (Canon Rebel XTi, Nikon D40, and the like) will shoot in a RAW format (many times at the same time as JPEG or TIFF). Shooting in RAW captures the original data that was seen by the camera’s CMOS sensor when the photograph was snapped, allowing the user to adjust properties such as exposure and white balance, after the photograph was taken. By eliminating the compression in the camera, a higher quality image is obtained at the capturing phase of your image.

Image capture in a digital camera is as simple as point and shoot; most models offer zoom lenses, and some offer interchangeable lenses and lighting and aperture features similar to a 35mm film camera. Most entry-level digital cameras store the images to card storage such as Compact Flash, Secure Digital, and SmartMedia. These cards store large amounts of images but may require an additional reading device to be connected to the computer for image transfer. Most cameras offer a USB 2.0 interface for quick transfer of data to your computer’s hard drive. Photo editing software is often bundled with digital cameras, enhancing their value as a digital image capture tool.

Webcams
Computer mounted video cameras, such as the Logitech QuickCam and Apple iSight are designed for onscreen video communication but offer another way of capturing still images. Connected directly to the computer, these cameras will normally capture up to a 640x480 still image directly to the hard drive as a PICT, JPEG, or BMP file, where it can be opened in image editing software and tweaked.

Video Capture and Still Screen Capture
Capturing video and still shots from a video source are alternate ways of acquiring digital images, provided you have a video player and a computer with video inputs. To perform this task, most computers will require the installation of a third-party video capture card. The capture card may or may not include video capture software to capture both video and still images. Consult the hardware documentation for compatibility and requirements.

Digital video cameras and playback equipment may plug directly into the computer and interface with existing software such as Apple iMovie or Windows Movie Maker. Either of these programs make it easy to capture still frames or video from a digital camera.

Computer Screen Capture
Computer screen captures are especially useful when demonstrating computer techniques or software features or designing sites for a particular web browser. On the Mac, Command/Shift/3 will create a snapshot of the entire screen and store it as a PNG file on the Desktop; a Windows
computer will load a BMP file into the clipboard when the Print Screen key is pressed. Shareware and freeware software are available for both computer platforms that enhance the selection of specific areas of the screen for capture.
Topic #6 - Graphics - Simple Animation

- The instructor will explain basic techniques for creating animations.
- The instructor will explain file formats such as GIF, MOV and SWF, which may contain animations.

Class Activities #6
- Students will create simple animations illustrating musical concepts and save or convert the figures to an appropriate file.
- Students will complete worksheet #6.

NOTES:
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

Digital Media - TI:ME 2B - Student Manual
Page 32
**Topic #6 Notes - A: GIF Animation**

The following steps outline the process for creating an animated GIF file.

1. Draw the frames of the animation with a drawing program.
   
   The following drawings create a single-handed clock with a quick rotation.

   ![Clock Animation Frames](image)

   If the drawing program does not support saving animated GIFs or MOV files then paste the frames of the animation into a program that does.

2. Set the looping feature of the animation to “forever” if desired.

3. Set the frame delay for each frame as desired.

4. Save the file as an animated GIF file or as a MOV file.
Topic #6 Notes - B: Flash Animation

On the page above techniques for creating animations using GIF files were presented. While GIF files are universally supported on the web, their development can be quite tedious. They require the individual creation of each frame in the animation sequence. Adobe® Flash®, an alternative animation format speeds development by letting the computer create screens between specified starting and ending points, called “tweening.” Flash files permit animation and a host of additional features including the addition of buttons, text fields, and basic programming (scripting). This article will cover the creation of a basic animation in Flash.

First, launch Flash and create a new project. Specify the size of the animation in pixels and the number of frames per second. A window like the one below will appear.

You can use the drawing tools to the left of the screen to draw a background if desired.
At this point, you can draw an object to move across the background, or drag an image in from a graphic file on your hard drive. Place the object in its desired starting point. This can be off screen if appropriate.

![Timeline screen](image1)

Next the desired duration of the animation will be set. Click on the frame in the timeline that will be the ending position of the moving object (24 in the screen below).

![Timeline screen](image2)

Now insert a keyframe at this point in the movie. (Insert>Keyframe.)

![Timeline screen](image3)
Click on the keyframe just created and drag the object to its desired ending position. Again, this can be off the screen if desired.

Select the object to be moved and click on any frame in the middle of the timeline. Next, set the “Tween” to “Motion” in the popup menu at the bottom of the screen. The object will move to the location where it should be at that point in the animation. From the Command menu choose “Run” and watch the object move across the screen.

Additional layers can be added to each animation (Insert>Layer) and additional objects added to each layer, each with its own animation behavior. Flash supports numerous other techniques for animation including having objects change size, color, brightness, and more. There are numerous helpful tutorials online and in Flash itself (check the help menu).
Topic #7 - Digital Audio

- The instructor will demonstrate how to add existing sounds to a multimedia presentation program.
- The instructor will demonstrate the process for recording sounds.
- The instructor will explain cut and paste editing.
- THE INSTRUCTOR WILL DEMONSTRATE HOW TO ADD EFFECTS SUCH AS DELAY OR REVERB.
- The instructor will demonstrate looping programs and how they may be used to construct digital audio compositions from pre-recorded loops.
- The instructor will demonstrate the process for saving or converting the sound file to an appropriate format.
- The instructor will explain podcasting and instructional uses of podcasts.

Class Activities #7

- Students will add existing sounds to a multimedia presentation program.
- Students will record themselves counting to four.
- Students will cut and paste the numbers so that they count backwards.
- Students will save the recording and convert it to a wav file.
- Students will create an audio file, which illustrates a musical concept and is appropriate for use in the music classroom.
- Students will complete worksheet #7a.
- Students will complete worksheet #7b.
- Students will read the appendix on podcasting.
- STUDENTS WILL PREPARE AND POST A PODCAST TO THE WEB.

NOTES:

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________
**Topic #8 - MIDI**

- The instructor will demonstrate how to add existing MIDI files to a multimedia presentation program.
- The instructor will demonstrate how to play and edit standard MIDI files.
- The instructor will demonstrate techniques for cutting, copying, pasting, transposing, muting or soloing tracks, and reorchestrating the song.
- The instructor will lead a discussion contrasting MIDI files with other types of audio files.
- The instructor will demonstrate looping programs and how they may be used to construct MIDI compositions from pre-recorded loops.

**Class Activities #8**

- Students will add existing MIDI files to a multimedia presentation program.
- Students will open a standard MIDI file and perform a variety of edits.
- Students will then save the file in a variety of formats (type 1, type 0).
- Students will convert MIDI files to digital audio files.
- Students will discuss why different music file formats exist, compare files sizes for the same information and postulate what information is different between the files.
- Students will create a MIDI file or loop-based composition which illustrates a musical concept and is appropriate for use in the music classroom.
- Students will complete worksheet #10.

**NOTES:**

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________
Topic #9 - Digital Video

- The instructor will demonstrate how to add existing video files to a multimedia presentation program.
- The instructor will demonstrate the process for recording digital video.
- The instructor will explain the massive storage requirements of digital video and how to compensate for this limitation.
- The instructor will demonstrate the effective use of a few seconds of video and the effective use of small windows.
- The instructor will demonstrate basic editing techniques such as setting in and out points, cutting, splicing, and adding transitions.
- The instructor will demonstrate the process for adding music and audio tracks.
- The instructor will demonstrate the process for saving or converting the video file to an appropriate file format.
- The instructor will explain compression and how to select the proper compression scheme for each distribution medium.

Class Activities #9

- Students will add existing video files to a multimedia presentation program.
- Students will record a video of themselves saying, "Hello! Welcome to my multimedia project."
- Students will save the recording and convert it to a MOV file.
- Students will create a video illustrating a musical concept. In the creation of this video they will use basic editing techniques such as setting in and out points, cutting, splicing, adding transitions, and adding additional audio and music tracks.
- Students will complete worksheet #11.

NOTES:
**Topic #9 Digital Video – Notes**

**What is Digital Video?**
Any video that has been digitized, regardless of its source of origin, is considered digital video. This is distinct from DV, which is a digital video format. Digital video requires a large amount of storage space in a computer with adequate RAM and processing speed; digital video editing software is one of the most demanding pieces of software used on a computer. High-speed external FireWire, USB 2.0, or secondary internal hard drives are sometimes dedicated to capturing and storing digital video.

**Capturing Digital Video**
Footage from a video camera can be imported directly into a computer in a variety of ways. Digital video cameras generally have a FireWire port that permits direct import into a computer, digital to digital. Analog cameras and analog source tape must be converted to digital format via an analog to digital converter, either as a separate conversion device or built into a VCR. The footage is almost always imported via the video editing software. Digital video can also be downloaded from the web or captured from videotapes and DVD’s.

**Video Cameras**
Video cameras come in a variety of tape and disc storage formats; source from analog formats must be imported via a converter device as described above. Source footage from digital video cameras can be directly imported via FireWire with no loss in quality. As electronic devices continue to evolve, digital video can also be captured on some digital still cameras, some cell phones, and other small hand held devices, although these do not equal the quality of video captured on a dedicated video camera.

When choosing a digital video camera, check the compatibility requirements of the video editing software that you will be using. This is generally found in the user manual, or on the software manufacturer’s website. Some video cameras are now able to record in high definition (HD); once again, be sure to check compatibility with software.

**Editing Digital Video**

**Editing Software**
Most video editing programs operate in similar ways. All computer-based editors are considered “non-linear,” and most are non-destructive; in other words, the files can be accessed in any order, and the edits made within the program do not change the source material; they are only a series of directions for creating an edited video. An exception to the non-destructive mode is Apple iMovie, which actually changes the source files. A variety of media, such as audio, still images, and text or graphics, can be imported as well as video, either captured directly from a device or imported as a movie file. These media files can be edited into a movie, then rendered, compressed, and exported as a movie file that can be played within other programs.

**Importing media**
The editing software will determine what types of files can be imported and in what format. Generally, most image formats, uncompressed audio, and standard video codecs (compressor/decompressor, such as DV, Cinepak, Microsoft Video 1) can be imported. Many
compressed video files compressed with codecs such as MPEG-2, MPEG-4, and H.264 will not be able to be imported without first being re-compressed to another format. In addition, some video editing programs permit importing of layered Photoshop® images, which can then be animated by manipulating the layers of the image. Like files grouped together in folders or directories can often be imported as a single directory, automatically organized as a Bin.

**Images and graphics**
Check the video editing software for preferred image and graphic formats; there may be some limitations on uncompressed graphic files or recommendations for resolution and image dimensions. If importing vertical images, test to see if the images are automatically resized or surrounded by black when imported or moved to the preview windows. Images can be assigned a duration in frames or seconds so that they can be seen within the movie.

**Text**
Most video editing programs can internally generated text and titles, but often better quality text can be imported as graphic file.

**Titling**
In addition to one video track, most video editing programs will include a title track that can contain software-generated titles. Titles are primarily for text, and common configurations include full screen informational titles, and lower third identification. In professional editing software, text will need to be manually inserted onto a normal video track.

**Audio**
Audio can be imported as an individual file or attached to imported video. Some video editing software also provides tools to create “voiceovers” within the program. Compressed audio, such as MP3s, may require a preview render before they can be audibly previewed in the Timeline.

**Video**
Most compressed video formats (MOV; MPEG; AVI, etc.) can be imported into semi-pro and professional video editing software, but must be converted to an interstitial codec before editing. Some consumer software such as iMovie may only permit importing of directly captured video from a camera or VCR.

**Working on a Timeline**
All professional video editing programs use a timeline structure for laying out the various elements of the project, but some programs offer a storyboard or scripting view as well. Generally, there is a bin or storage area for the various imported source materials and a timeline to which these elements, usually called “clips,” can be dragged. The Timeline is the main but not only editing area, in essence a visual and aural sequencer in which source clips can be manipulated and moved. Clips can be trimmed, cut, recomposed, and moved around, all without changing the original source material. All programs have at least one video “track” and at least one stereo audio track on the timeline in order to allow artistic transitions between the clips. The similarities to MIDI sequencing and audio editing programs make the timeline easy for musicians to grasp and use.
Transitions
A variety of transitions, such as dissolves and wipes, can be inserted between clips on the timeline, providing sophisticated manipulation of the material, whether audio, video, titles, etc. Most often, these are available in a drag and drop format and can be previewed in advance.

Special Effects
Most editing programs provide a variety of special effects, where visual manipulation, audio effects, or panning and zooming of still images as frequently used in documentary films. Sometimes referred to the “Ken Burns effect” (the famous documentary director), panning across and zooming in and out of still images can create the illusion of moving video, particularly useful as a substitution when video footage is not available. All special effects should be used with discretion and caution.

Using layered images for animation effects
Some advanced programs allow importing of layered Photoshop® images, whose layers can then be animated on the timeline. Out points of photos can usually be dragged on the Timeline for however many frames or seconds they are to be viewed on the screen. This can be particularly useful in creating animated titles and text. Caution should be used to make sure that critical text is well within the ”safe zone” of the screen so that text is not accidentally cut off from the edges of the screen, especially during animation sequences.

Preview and rendering
Most video editing programs require the rendering of any edits, transitions, effects, and so on, before the video can be prepared for final export. Sometimes the rendering is required to view the edits. On slower computers, rendering can take an enormous amount of time.

Exporting movies
Exporting digital video creates movie files that are recognized by other multimedia software; be sure to check which file formats work with the multimedia software you will be using. The export process usually offers a variety of sizes and formats, including streaming video for web delivery. These are often found under an Export menu or under a “Save as” command window with pull down menu options. In general, video for web and podcast delivery should be saved in small screen sizes (320x240), whereas video intended for DVD or CD-ROM delivery can be saved in larger screen sizes (640x480 or 720x480 DV). Most video editing programs also allow the export of edited video back to the original camera.

Compression
An enormous variety of options exist in the realm of digital video compression. Advanced codecs such as H.264 and MPEG-4 exist to enhance the quality of web-distributed content, while continuously reducing file size. Care must always be taken to use the proper codec for each digital video end-use. A delicate balance must be achieved between file size and image quality, which is much easier to achieve when the correct codec and video frame size is used. The standard frame rate for DV is 29.97 (roughly 30) frames per second. Frame rate may be reduced to reduce file size. Videos compressed at 15 frames per second have acceptable motion for the web, but would not be considered acceptable for television.
Topic #10 - Copyright Issues

- The instructor will lead a discussion on copyright issues related to multimedia materials.
- Topics to be covered include the legal and prohibited uses of existing materials, the rights to control display and distribution of copyrighted materials, the need for appropriate copyright notices, and the issues related to producing derivative works.

Class Activities #10

- The student will participate in a discussion on copyright issues and will complete a worksheet on the topic.
- The student will complete worksheets #12A and 12B.

NOTES:

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
Topic #11 - Curriculum Integration

- The instructor will lead a discussion on integrating multimedia files into the curriculum.

Class Activities #11

- The student will participate in a discussion on curriculum integration and will complete worksheet #13.

NOTES:

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
Topic #12 - Individual Project

- The instructor will define parameters for the student’s final multimedia project. This may consist of multimedia combined using a presentation program or stand-alone multimedia such as video or audio recordings.

Class Activities #12
- The student will design and create a web page for use in a music class.
- The student will complete worksheet #14.

NOTES:

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________
1. Describe the elements of multimedia.
   a. Text
   b. Graphics
   c. Sounds
   d. MIDI files
   e. Movies

2. Comment on the various types of multimedia files.
   **Text:**
   - TXT
   - HTM
   - PDF
   - RTF

   **Graphics:**
   - GIF
   - JPG
   - PNG

   **Animations:**
   - GIF
   - MOV
   - SWF

   **Sounds:**
   - WAV
   - AIF
   - MP3
   - AAC

   **MIDI:**
   - MID

   **Movies:**
   - MOV
   - WMV
1. List tips for the effective use of text in multimedia presentations.

2. How does one enter text into a presentation program?

3. Comment on each of the following text files. How does one open or view the following files?

   TXT

   HTML

   PDF

   RTF
1. How does one convert a paper containing text into a text file?

2. How does one create a PDF file?
STUDENT WORKSHEET 3

Graphics

1. Why would one use graphics in a multimedia presentation?

2. How does one enter graphics into a presentation program?

3. How does one create images with a drawing program?

4. How does one capture images with a scanner?

5. How does one capture images with a digital camera?

6. How does one create notation for use in a multimedia presentation?

7. What are the advantages and disadvantages of various graphic file formats?
   GIF
   JPG
   PNG
   BMP
   PICT
   TIFF
STUDENT WORKSHEET 4
Graphics - Drawing and Painting Software

1. How does one import a graphic file into a drawing program?

2. How does one crop an image in a drawing program?

3. How does one correct color and brightness settings in a photograph?

4. How does one convert a color photograph to gray scale or black and white?

5. How does one resize an existing picture?

6. How does one draw a simple picture (stick figure or better) using the tools of a painting/drawing program?

7. How does one copy and paste a portion of a picture.

8. How does one add a custom background and or texture to a picture?

9. How does one save a picture to an appropriate graphic format?
The following concepts are important when scanning pictures for multimedia presentations. Explain each:

A. Resolution of Scan

B. Color Depth

C. Image Size (in pixels)

D. Other Tips
Digital Media
STUDENT WORKSHEET 5B
Using a Digital Camera

Describe the steps required to take pictures with a digital camera, download them to a computer, and prepare them for use in a multimedia presentation.

1.

2.

3.

4.

5.
1. How does one create animations?

2. Discuss file formats that support animations:
   
   GIF

   MOV

   SWF
1. List some ways to use sounds in a multimedia presentation.

2. How does one add sound to a multimedia presentation?

3. How does one create new sound files?

4. What are other issues to consider when recording sound?

5. How does one perform copy and paste editing with a sound program?

6. HOW DOES ONE ADD EFFECTS SUCH AS REVERB OR DELAY TO A SOUND?

7. How does one save a sound in an appropriate file format?
The following concepts are important when recording digital audio on the computer.

A. Sound Source and Input
   Sound input may be from a microphone, electric guitar, synthesizer, tape player, or any device which produces an appropriate electronic signal. Check the level of sound being input, since devices send out varying strength of signals.

B. Sample Depth (8-bit, 16-bit)
   When sounds are converted to a digital format, they are commonly be saved with either eight or sixteen bits of precision. Saving with sixteen bits produces a more accurate representation of the original sound. Saving at eight bits sometimes produces noise and intonation problems.

C. Sample Rate
   When recording voices a sampling rate of at least 8,000 times per second is adequate. When recording music a sampling rate of 20,000 is acceptable. A sampling rate of 44,100 (44.1 kHz) is used when music is recorded to compact discs. This eliminates all annoying acoustic phenomena such as pitch shifts and noise.

D. Monaural or Stereo Recording
   Recording stereo doubles the file size. Since file size is such a significant issue for Internet users, monaural is usually the best choice for the Internet. Sounds to be written to CD must be in stereo format.

E. File Size and Compression
   Depending on the software used, you may or may not have options that allow sound to be compressed. Some loss of sound quality occurs with some compression schemes. Experiment but keep a copy of your original sound so you can revert if necessary. When saving files for the Internet it is important to produce files which can be played on Macintosh or Windows computers. Choose compression that can be recognized on both platforms.

F. File Types
   WAV is the most common and is adequate for most purposes.
   AIF is a very useful sound format which supports a number of sample rates, depths, and compressions.
   MP3 is a compressed sound format that maintains quality and is supported by most players.
   AAC is a compressed sound format that maintains quality and is supported primarily by iTunes.

G. Other Tips
   When file size is a concern:
   • Use MIDI files for music.
   • Sample WAV or AIF files at the lowest acceptable rate.
   • Use MP3 or AAC files when possible.
   • Keep samples short (a few seconds is best).
   • Remove silence and/or noise at the beginning and end
   • Use compression standard to both Mac and Windows platforms.
STUDENT WORKSHEET 8A
MIDI

1. What is a MIDI file and how can it be used in a multimedia presentation?

2. How does one add an existing MIDI file to a multimedia presentation?

3. How does one edit an existing MIDI file?

4. What are the different types of MIDI files?
5. When working with Standard MIDI Files, the following concepts are important. Explain each:

A. Digital Audio vs. MIDI

B. Playback Device

C. Arranging Artfully for the Worst Possible Playback Device

D. General MIDI and Patches

E. Other Tips
1. Why would one use a video in a multimedia presentation?

2. How does one add existing video files to a multimedia presentation?

3. How does one record a digital video?

4. How does one copy and paste portions of the video?

5. How does one add special effects such as transitions?

6. How does one add additional audio or music tracks to a movie?

7. How does one save video in an appropriate file format?
9. When capturing digital video on the computer, all of the guidelines for digitizing pictures and sound apply. The following concepts are also important. Explain each:

A. Video Source and Input

B. Frame Rate

C. File Size and Compression

D. File Types

E. Other Tips
Those who create multimedia materials and presentations and lessons should understand the copyright law. There is a great temptation to borrow or make derivative works from existing multimedia materials. The right of creative people to control the display and circulation of their work is assured by law. As a general guideline, however, a copyright notice must be displayed on copyrighted material. If no notice is displayed, the material may be used but out of courtesy, permission should still be requested. If a copyright notice is displayed, then permission for using the material must be obtained from the copyright owner before using the material. On the Internet, copyright permissions are easily obtained using e-mail. All materials not created by the author should contain a complete citation giving credit to the source.

For further information, refer to:

The United States Copyright Law - A Guide for Music Educators

http://www.menc.org/information/copyright/copyr.html

Comments:
Those who create multimedia materials and presentations and lessons may produce materials needing copyright protection. Content creators need to understand the rights provided by copyright and the process for registering different kinds of works.

For further information, refer to:
The United States Copyright Office website
http://www.copyright.gov

Questions:

YES  NO  Does copyright protect literary, dramatic, musical, and artistic works, such as poetry, novels, movies, songs, computer software, and architecture?

YES  NO  Does copyright protect facts, ideas, systems, or methods of operation?

YES  NO  Does copyright protect the way facts, ideas, systems, or methods of operation are expressed?

YES  NO  Does copyright protect names, titles, slogans, or logos?

Who may copyright a work?  The author, composer, or producer or their agent/publisher.

When may a work be copyrighted?  After it has been fixed in a permanent medium.

Does a copyright have to be registered?  No, immediately after creation and fixing a composition in a permanent medium, the owner controls copyright. However, to address violations, the copyright should normally be registered.

What are the rights of copyright holders?  To control the duplication of their works, to control the creation of arrangements and derivative works, to control the sale, rental, and distribution of the work, to control performances and display of the work, to control the performance of recordings of the work.

When securing a copyright, a work must be entered into the proper category. Match the following copyrightable works with their U.S. Copyright categories.

____ 1. Compositions
____ 2. CD of a Concert
____ 3. Movie
____ 4. Books
____ 5. Paintings
____ 6. Magazines

a. Performing Arts
b. Sound Recordings
c. Literary Works
d. Visual Arts
e. Serials/Publications

Describe International Copyright considerations:  Registering a U.S. Copyright provides protection in countries which have copyright agreements with the U.S.  See the U.S. Copyright Office web site for a list of countries with and without agreements.

Comments:

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

ANSWERS:  a, b, a, c, d, e  See http://www.copyright.gov/register/
STUDENT WORKSHEET 13
Digital Media, the National Standards and the Technology Strategies for Music Education

1. Which MENC national standard(s) can be addressed using digital media software? Explain specific ways digital media can be used to address these standards?

______________________________________________________________________
______________________________________________________________________
______________________________________________________________________
______________________________________________________________________
______________________________________________________________________
______________________________________________________________________
______________________________________________________________________

MENC Standards:
1. Singing, alone and with others, a varied repertoire of music.
2. Performing on instruments, alone and with others, a varied repertoire of music.
3. Improvising melodies, harmonies, and accompaniments.
5. Reading and notating music.
6. Listening to, analyzing and describing music.
7. Evaluating music and music performances.
8. Understanding relationships between music, the other arts, and disciplines outside the arts.
9. Understanding Music in Relation to History and Culture.

2. Now review the Teaching Strategies listed in the TI:ME technology strategies document. See Appendix A of the Technology Strategies for Music Education. Which ones from the notation area are most applicable to your teaching position? How could these strategies be best implemented in your classroom? [TIME INSTRUCTORS MAY PHOTOCOPY AND DISTRIBUTE APPENDIX A]

<table>
<thead>
<tr>
<th>TI:ME Tech. Strategy #</th>
<th>Teaching Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ________________</td>
<td>____________________</td>
</tr>
<tr>
<td>Classroom Implementation</td>
<td>____________________</td>
</tr>
<tr>
<td>2. ________________</td>
<td>____________________</td>
</tr>
<tr>
<td>Classroom Implementation</td>
<td>____________________</td>
</tr>
<tr>
<td>3. ________________</td>
<td>____________________</td>
</tr>
<tr>
<td>Classroom Implementation</td>
<td>____________________</td>
</tr>
<tr>
<td>4. ________________</td>
<td>____________________</td>
</tr>
<tr>
<td>Classroom Implementation</td>
<td>____________________</td>
</tr>
</tbody>
</table>
1. Describe the project to be completed for this class.

2. Describe how this project can be used in the classroom.
Appendix 1

Digital Media
Software Recommendations

Multimedia authoring software is generally in rapid transition and many products come as go as the result of corporate purchases and takeovers. Furthermore, the features of these products vary with time. TI:ME recommends the use of currently available, cross-platform software. Instructors should confirm that these programs meet these criteria.

### Presentation Programs

<table>
<thead>
<tr>
<th>Publisher</th>
<th>Title</th>
<th>Web Address</th>
<th>Platform</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microsoft</td>
<td>PowerPoint</td>
<td><a href="http://www.microsoft.com/powerpoint/">http://www.microsoft.com/powerpoint/</a></td>
<td>Mac/Win</td>
</tr>
<tr>
<td>Apple</td>
<td>Keynote</td>
<td><a href="http://www.apple.com/keynote/">http://www.apple.com/keynote/</a></td>
<td>Mac</td>
</tr>
<tr>
<td>Apple</td>
<td>QuickTime Pro</td>
<td><a href="http://www.apple.com/quicktime/">http://www.apple.com/quicktime/</a></td>
<td>Mac/Win</td>
</tr>
</tbody>
</table>

### Digital Audio

<table>
<thead>
<tr>
<th>Publisher</th>
<th>Title</th>
<th>Web Address</th>
<th>Platform</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bias, Inc.</td>
<td>Peak</td>
<td><a href="http://www.bias-inc.com/">http://www.bias-inc.com/</a></td>
<td>Mac</td>
</tr>
<tr>
<td>Sony</td>
<td>Sound Forge</td>
<td><a href="http://www.sonycreativesoftware.com/products/product.asp?PID=431">http://www.sonycreativesoftware.com/products/product.asp?PID=431</a></td>
<td>Win</td>
</tr>
<tr>
<td>Adobe®</td>
<td>Audition®</td>
<td><a href="http://www.adobe.com/products/audition/">http://www.adobe.com/products/audition/</a></td>
<td>Win</td>
</tr>
<tr>
<td>Apple</td>
<td>Garage Band</td>
<td><a href="http://www.apple.com/garageband/">http://www.apple.com/garageband/</a></td>
<td>Mac</td>
</tr>
<tr>
<td>Apple</td>
<td>SoundTrack Pro</td>
<td><a href="http://www.apple.com/soundtrack/">http://www.apple.com/soundtrack/</a></td>
<td>Mac</td>
</tr>
</tbody>
</table>

### Image Editing

<table>
<thead>
<tr>
<th>Publisher</th>
<th>Title</th>
<th>Web Address</th>
<th>Platform</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adobe®</td>
<td>Photoshop®</td>
<td><a href="http://www.adobe.com/products/Photoshop%C2%AE/">http://www.adobe.com/products/Photoshop®/</a></td>
<td>Mac/Win</td>
</tr>
<tr>
<td>GIMPShop</td>
<td>GIMPShop</td>
<td><a href="http://plasticbugs.com/?page_id=294">http://plasticbugs.com/?page_id=294</a></td>
<td>Mac/Win</td>
</tr>
</tbody>
</table>

### Video Editing

<table>
<thead>
<tr>
<th>Publisher</th>
<th>Title</th>
<th>Web Address</th>
<th>Platform</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>Final Cut Studio</td>
<td><a href="http://www.apple.com/finalcut/">http://www.apple.com/finalcut/</a></td>
<td>Mac</td>
</tr>
<tr>
<td>Apple</td>
<td>iLife</td>
<td><a href="http://www.apple.com/ilife/">http://www.apple.com/ilife/</a></td>
<td>Mac</td>
</tr>
<tr>
<td>Adobe®</td>
<td>Premiere®</td>
<td><a href="http://www.adobe.com/products/premiere">http://www.adobe.com/products/premiere</a></td>
<td>Win</td>
</tr>
<tr>
<td>Adobe®</td>
<td>After Effects®</td>
<td><a href="http://www.adobe.com/products/aftereffects">http://www.adobe.com/products/aftereffects</a></td>
<td>Win</td>
</tr>
<tr>
<td>Pinnacle</td>
<td>Studio</td>
<td><a href="http://www.pinnaclesys.com/">http://www.pinnaclesys.com/</a></td>
<td>Win</td>
</tr>
</tbody>
</table>

### Web Page Authoring

<table>
<thead>
<tr>
<th>Publisher</th>
<th>Title</th>
<th>Web Address</th>
<th>Platform</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adobe®</td>
<td>GoLive®</td>
<td><a href="http://www.adobe.com/products/golive/">http://www.adobe.com/products/golive/</a></td>
<td>Mac/Win</td>
</tr>
<tr>
<td>Microsoft</td>
<td>FrontPage</td>
<td><a href="http://www.microsoft.com/frontpage/">http://www.microsoft.com/frontpage/</a></td>
<td>Mac/Win</td>
</tr>
<tr>
<td>Adobe®</td>
<td>DreamWeaver®</td>
<td><a href="http://www.adobe.com/software/dreamweaver/">http://www.adobe.com/software/dreamweaver/</a></td>
<td>Mac/Win</td>
</tr>
</tbody>
</table>
## Interactive Authoring

<table>
<thead>
<tr>
<th>Publisher</th>
<th>Title</th>
<th>Web Address</th>
<th>Platform</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adobe&lt;sup&gt;®&lt;/sup&gt;</td>
<td>Flash</td>
<td><a href="http://www.adobe.com/software/flash">http://www.adobe.com/software/flash</a></td>
<td>Mac/Win</td>
</tr>
<tr>
<td>Adobe&lt;sup&gt;®&lt;/sup&gt;</td>
<td>Director</td>
<td><a href="http://www.adobe.com/software/director">http://www.adobe.com/software/director</a></td>
<td>Mac/Win</td>
</tr>
<tr>
<td>Roger Wagner</td>
<td>HyperStudio</td>
<td><a href="http://www.hyperstudio.com/">http://www.hyperstudio.com/</a></td>
<td>Mac/Win</td>
</tr>
<tr>
<td>Multimedia Design Corp.</td>
<td>mPower on the Web</td>
<td><a href="http://www.mpower.net/">http://www.mpower.net/</a></td>
<td>Mac/Win</td>
</tr>
<tr>
<td>Sumtotal</td>
<td>Toolbook</td>
<td><a href="http://www.toolbook.com/">http://www.toolbook.com/</a></td>
<td>Win</td>
</tr>
<tr>
<td>Adobe&lt;sup&gt;®&lt;/sup&gt;</td>
<td>Authorware</td>
<td><a href="http://www.adobe.com/products/authorware/">http://www.adobe.com/products/authorware/</a></td>
<td>Mac/Win</td>
</tr>
<tr>
<td>Runtime Revolution</td>
<td>RunRev</td>
<td><a href="http://www.runrev.com/">http://www.runrev.com/</a></td>
<td>Mac/Win</td>
</tr>
</tbody>
</table>
What is Text?
Text is the graphic representation of speech. Unlike speech, however, text is silent, easily stored, and easily manipulated. Text in multimedia presentations makes it possible to convey large amounts of information using very little storage space. Computers customarily represent text using the ASCII (American Standard Code for Information Interchange) system. The ASCII system assigns a number for each of the characters found on a typical typewriter. Each character is represented as a binary number that can be understood by the computer. On the Internet, ASCII can be transmitted from one computer to another over telephone lines. Non-text files (like graphics) can also be encoded as ASCII files for transmission. Once received, the ASCII file can be translated by decoding software back into its original format.

Fonts
The graphic representation of speech can take many forms. These forms are referred to as fonts or typefaces. Fonts can be characterized by their proportionality and their serif characteristics.

Non-proportional fonts, also known as monospaced fonts, assign exactly the same amount of horizontal space to each character. Monospaced fonts are ideal for creating tables of information where columns of characters must be aligned. Text created with non-proportional fonts often look as though they were produced on a typewriter. Two commonly used non-proportional fonts are Courier and Monaco on the Macintosh, and Courier New and FixedSys on Windows.

Proportional fonts vary the spacing between characters according to the letter. For example, an "l" requires less horizontal space than a "d". Text created with proportional fonts look more like a professional typographer typeset them. Two commonly used proportional fonts are Times and Helvetica on the Macintosh, and Times New Roman and Arial on Windows. This article is written using a proportional font.

Serif fonts are designed with small ticks at the bottom of each character. These ticks aid the reader in following the text. Serif fonts are generally used for text in the body of an article because they are easier to read than Sans Serif fonts. The body text in this article is written using a serif font. Two commonly used serif fonts are Times and Courier on the Macintosh and Times New Roman and Courier New on Windows.

Sans Serif fonts are designed without small ticks at the bottom of each character. Sans Serif fonts are generally used for headers within an article because they create an attractive contrast with the Serif fonts used in the body text. The section headers in this article are written using a sans serif font. Two commonly used sans serif fonts are Helvetica and Monaco on the Macintosh and Arial and FixedSys on Windows.
Font Samples
Times and Times New Roman are proportional serif fonts.
Helvetica and Arial are proportional sans serif fonts.
Courier and Courier New are non-proportional serif fonts.
Monaco and Lucida Sans Typewriter are non-proportional sans serif fonts.

Font Standards
There are basically two font standards of interest today. The first is called Postscript. Postscript fonts are designed to produce exceptionally good-looking type when printed on a high-resolution printer. To use a Postscript font, a set of files must be installed on the host computer. These files include a printer font that is downloaded to the printer when a page containing the font is printed, and a set of screen fonts, which represent the font on screen at various point sizes. If the user chooses to view the font at a size not provided for by the font file, the computer interpolates and produces an unattractive font on screen. The printed output, however, will always appear attractive. Postscript is a complete page description language that encompasses all elements of a printed page including high-resolution graphics. Postscript was created by Adobe in the mid 1980s and, combined with the introduction of the Macintosh and the Apple LaserWriter printer, created an industry called desktop publishing.

The second standard is called TrueType. TrueType fonts use a variant of postscript technology. To use a TrueType font only one file must be installed on the host computer. This file is used by the printer and by the screen to produce attractive text at any point size. TrueType technology, however, is limited to text. For high-resolution graphics, Postscript is the standard to use. Microsoft created TrueType in the early 1990s, in cooperation with Apple Computer (now Apple, Inc.), and other companies.

Both Macintosh and Windows computers commonly use TrueType fonts. Postscript technology, however, is much more commonly available on the Macintosh platform because of its dominance in the desktop publishing and multimedia production industries.

Styles and Sizes
Styles such as Bold, Underlined, and Italic can be applied to most fonts. The size of the font also can be altered through software commands.

File Formats
Text created on a computer is stored as a file on a hard disk or floppy disk. The ASCII file format, a.k.a. plain text, is universally understood by all computer systems. A more complex standard called Rich Text Format (RTF) was developed by Microsoft to allow for the exchange of word processing files that include formatting such as text alignment, font styles, and font sizes. Although RTF is proprietary technology, it has become a de facto standard for exchanging formatted text documents. A quickly emerging replacement for RTF, however, is HTML (HyperText Markup Language), which is used for creating web pages. HTML files are really just ASCII text files. The content of HTML files, however, contains a standard set of markings to indicate text styles, alignments, hypertext links, graphics, and other formatting essentials. HTML files can be read by web browser software like Internet Explorer, Safari, and Firefox. Many word processors today are also equipped to interpret HTML. Other file formats such as the native file formats used by Microsoft Word, WordPerfect, and Apple Pages are proprietary
and not universally understood. When preparing electronic documents for a wide audience, therefore, it is best to use ASCII, RTF, or HTML.
Today many intrepid educators are taking the plunge into multimedia. Multimedia development tools like HyperCard for the Macintosh Classic environment, SumTotal Toolbook for Windows, cross-platform PowerPoint, and the World Wide Web can help educators create educational programs that are motivating and fun. Creating sound for use in these environments requires a minimal understanding of the science behind sound, and knowledge of some of the jargon involved in multimedia.

What is Sound?
If a tree falls in the forest and no living creature is there to hear it, does it make a sound? The answer is no. Sound is a perceptual phenomenon only. When a tree falls, a person speaks, or a violin string vibrates, the surrounding air is disturbed causing changes in air pressure that are called sound waves. When sound waves arrive at our ears they cause small bones in our ears to vibrate. These vibrations then cause nerve impulses to be sent to the brain where they are interpreted as sound.

How is Sound Recorded?
Sound waves can be transduced (converted to another form) using a microphone. A microphone is similar to the human ear in that it has a diaphragm, which vibrates in response to changes in air pressure. The movements of the diaphragm within an electromagnetic field cause changes in electrical voltage. These voltage changes can be directed to a tape recorder, which alters the magnetic particles on the tape to correspond to the voltage changes. A "picture" of the sound...
then exists on the tape. When you press play on the tape recorder, the "picture" is read back as a series of voltage changes, which are then sent to a speaker. The voltage changes cause an electromagnet within the speaker to push and pull on a diaphragm. The movement of the diaphragm then causes air pressure changes, which our ears interpret as the original sound. This process is known as analog recording because the picture of the sound on the tape is analogous to the original changes in air pressure caused by the sound event.

Figure 2 - analog recording

When sound waves strike a microphone, they are converted to an electrical signal, which is then etched onto a magnetic tape.

Digital recording differs from analog recording in that the "picture" of the sound is created by measuring the voltage changes coming from the microphone and assigning numbers to each measurement. The term "sampling" is used to describe the process of measuring an electrical signal's voltage thousands of times per second at a given level of precision (resolution). The number of measurements per second is called the "sampling rate" and is expressed as kilohertz (kHz). A rate of 11,000 measurements per second is thus designated as 11 kHz. Sampling rates range from 5 kHz to 48 kHz with higher rates being used for the best quality recordings.

The number of measurements per second, however, is only part of the picture. The degree of precision within each measurement is also important. This is known as "sampling resolution". Sampling resolution is used to divide the total range of the electrical voltage into discrete parts. Common sampling resolutions in use today are 8-bit and 16-bit. Sampling at 8-bits divides the voltage into 256 parts (2 to the 8th power). Sampling at 16-bits divides the voltage into 65,536 parts (2 to the 16th power). Using a higher sampling resolution creates cleaner recordings with less background noise.

All of these measurements are made by an analog-to-digital converter. The measurements can then be stored as binary numbers in a file on a computer's hard disk. To play back the sound, the computer sends the information in the file to a digital-to-analog converter, which reproduces the original electrical signal. That signal is then sent to a speaker, which produces the sound as described earlier.

Maximum precision per measurement combined with maximum sampling rates produces the highest quality recordings. To describe a digital recording of a sound, therefore, one can speak of the sampling rate and resolution. For example, sound recorded at a sampling rate of 22 kHz with 8-bit resolution is considered to be of a quality similar to that of a telephone call. Sound
recorded at 44.1 kHz and 16-bits is considered the minimum quality for compact disc recordings because it captures the full range of human hearing. In multimedia production work, 11 kHz, 8-bit sound is sometimes acceptable for speech recordings and 22 kHz, 8-bit resolution or 11 KHz, 16-bit resolution is often considered acceptable for music. For the highest-level multimedia work, however, nothing short of 44.1 kHz, 16-bit sound is acceptable.

Figure 3 - digital recording
When sound waves strike a microphone, they are converted to an electrical signal, which is measured several thousand times per second by an analog-to-digital converter chip. The measurements are stored in the computer as binary numbers.

The higher the quality of sound, the more space it takes to store the sound. A compact disc can store about 74 minutes of stereo sound at 44.1 kHz, 16-bit. If you reduce the quality to 22 kHz, 8-bit stereo sound, however, you can store approximately 300 minutes of audio on the same disc. In other words, one minute of stereo sound takes 10 megabytes of storage at 44.1 kHz, 16-bit quality, and only 2.5 megabytes of storage at 22 kHz, 8-bit quality. When producing sound for multimedia, therefore, one must consider not only sound quality, but also how the sound will be distributed. If your multimedia program will be distributed on CD then you may have enough storage space to justify using the best quality. If the program will be distributed on disk or through the Internet, however, you would consider using lower quality sound to avoid having to distribute many disks or subject your users to long download times.

Sound File Formats
When sound is digitally recorded to a hard disk, the recording software assigns a file format. Sound files are either RAM-based or Disk-based. To play back a RAM-based file, your computer must have enough free random access memory (RAM) to hold the entire file. A Macintosh sound recording program, such as Garage Band or the open source Audacity can be used to create audio resources. These programs will record audio directly to the hard drive, then stream multiple tracks of audio simultaneously, through RAM, for listening.

Disk-based sound file formats allow you to record music of any length and quality. You are only limited by the amount of available storage space on your hard drive. Disk-based sound file formats are ideal for longer and/or higher-quality samples. AIFF (Audio Interchange File Format) is one of the most commonly used disk-based file formats on Macintosh, Windows, and even Unix computers. Stereo AIFF sound files recorded at 44.1 kHz, 16-bit quality are ideal for multimedia productions that will be distributed on CD. Monophonic AIFF sound files recorded at 22 kHz, 16-bit quality are better for multimedia productions that will be distributed via the
Internet because their file sizes are smaller than higher-quality samples. If you use the Internet frequently you have probably encountered sound files in WAV and AU formats. The WAV format is used by Microsoft Windows and computers running the UNIX operating system use the AU file format. Sound editing software can convert among these and many other file formats.
I have prepared five AIFF files of an excerpt from "Doodlin" by Horace Silver and John Hendricks. The files were recorded at different sampling rates and resolutions. The original AIFF files were all converted to QuickTime movies for use on the web. The differences in sound quality can be heard by playing the examples below. A change in sampling resolution from 16-bit to 8-bit produces more noise and degradation in quality than changes in sampling rate from 44.1 kHz to 22 or 11 kHz.

"Doodlin" – 44.1 kHz sampling rate, 16-bit sampling resolution, 644 kilobytes
http://www.ti-me.org/IWP/multimediabasics/doodle16.mov

"Doodlin" – 22 kHz sampling rate, 16-bit sampling resolution, 351 kilobytes
http://www.ti-me.org/IWP/multimediabasics/doodle1622.mov

"Doodlin" – 11 kHz sampling rate, 16-bit sampling resolution, 176 kilobytes
http://www.ti-me.org/IWP/multimediabasics/doodle1611.mov

"Doodlin" – 44.1 kHz sampling rate, 8-bit sampling resolution, 332 kilobytes
http://www.ti-me.org/IWP/multimediabasics/doodle844.mov

"Doodlin" – 22 kHz sampling rate, 8-bit sampling resolution, 195 kilobytes
http://www.ti-me.org/IWP/multimediabasics/doodle8.mov

The sound quality of the 11 kHz, 16-bit file is the best tradeoff between file size and sound quality. QuickTime movies containing AIFF sound files can be loaded onto any web server and included in web pages by using the appropriate code found in the "HTML Coding" section of the handout as seen below.

<EMBED SRC="doodle16.mov" AUTOPLAY=FALSE WIDTH=150 HEIGHT=24>

**MIDI**

The Musical Instrument Digital Interface (MIDI) is a hardware and software standard that, among other things, allows users to record a complete description of a lengthy musical performance using only a small amount of disk space. Standard MIDI Files can be played back using the sound synthesis hardware of a Mac or Windows. Using MIDI, Beethoven's Fifth Symphony uses about 1.3 megabytes of storage and can fit on one floppy disk. Using a digital audio file format like AIFF, the same symphony uses over 300 megabytes of hard disk storage. One problem with MIDI is that the quality of the actual sound you hear will vary depending on the quality of your computer's sound hardware. For educational applications, however, MIDI-generated sound can be used to demonstrate musical ideas quite effectively. Another problem with MIDI in the past was the lack of a standard sound set. A MIDI file designed to be played with piano and flute sounds might be realized with organ and clarinet on another person's computer. This problem was partially solved by the advent of the General MIDI standard, which created a standard set of 128 sounds. Virtually all MIDI files today are distributed in General MIDI format. Still it was left to the owner of each computer to be sure their sound hardware could play the General MIDI sounds. Apple Computer solved the problem with the latest version of its QuickTime software.
Demonstration 2 - MIDI and QuickTime

MULTIMEDIA BASICS: UNDERSTANDING SOUND - Demonstration 2

Steven G. Estrella, Ph.D.

The following QuickTime movie (http://www.time.org/IWP/multimediabasics/convertmidi.mov) demonstrates the process of converting a standard MIDI file into a QuickTime movie using the QuickTime application available from Apple's web site (www.apple.com or apple.com/quicktime).

An excerpt from "Doodlin" recorded as a standard MIDI file and converted to a QuickTime movie is found on the Internet at http://www.ti-me.org/IWP/multimediabasics/bachinv4.mid. This file takes up only 8 kilobytes of storage and would load in a few seconds via modem. This MIDI file, bachinv4.mid, may be downloaded for use in music sequencing or music notation applications.

Web sites can be used to exchange MIDI files, collaborate on MIDI sequences, and engage in group compositions. If you convert your MIDI files to QuickTime movies then multiple MIDI files can be embedded in a single page, allowing visitors to participate in a jam session with the music elements you provide. The Blues Jam page (http://www.time.org/IWP/bluesjam/bluesjam.html) is an example of this application.

Blues Jam

The QuickTime MIDI file of the rhythm section (music by Gino Cuammere) should begin playing after this page loads if your system is properly configured with the QuickTime plug-in. Please be patient, the rest of the page may take some time to load. The sax files are particularly large but they are worth the wait.

Click on any of the buttons below to play some cool licks to jam with the blues riffs.

<table>
<thead>
<tr>
<th>sax1</th>
<th>sax2</th>
<th>sax3</th>
<th>sax4</th>
</tr>
</thead>
<tbody>
<tr>
<td>synth</td>
<td>vibes</td>
<td>whistle</td>
<td></td>
</tr>
<tr>
<td>organ1</td>
<td>organ2</td>
<td>organ3</td>
<td>organ4</td>
</tr>
<tr>
<td>trumpets1</td>
<td>trumpets2</td>
<td>trumpets3</td>
<td>trumpets4</td>
</tr>
</tbody>
</table>
Apple QuickTime Software
One of Apple Computer's most brilliant innovations is the continuing development of QuickTime. QuickTime began as a set of system extensions to Macintosh System 7 to allow users to play digitized video in a small window on the screen. Today, QuickTime is a comprehensive multimedia tool for storing video, animations, and sound in a variety of formats. It is also a cross-platform tool, meaning that QuickTime movies can be viewed and heard using computers running Mac OS, Windows, or even UNIX.

So what does Apple's QuickTime technology have to offer educators? The answer is plenty. The free version of QuickTime Player, available from Apple's web site at http://www.apple.com, plays back QuickTime content. Content creators must purchase the "Pro" version of QuickTime for $30. The "Pro" version can convert standard MIDI files into QuickTime movies that can be played back by any Macintosh computer (Mac II or later) or any Windows computer with a sound card. QuickTime MIDI movies use just a little more disk storage space than the MIDI files on which they are based. The actual sound is produced by a software synthesizer that QuickTime installs on your computer's hard disk.

QuickTime Pro can be used to convert audio from compact discs into QuickTime movies that can be used in multimedia presentations. It can also be used to add sound and text tracks to digital video. Using a video recorder, Apple's free QuickTime software, and a Mac equipped with an external or internal iSight, you could record a movie demonstrating instrumental techniques and then use QuickTime to add a voiceover narrative. You could also add a descriptive voice narrative to a QuickTime MIDI movie containing a full performance of a complex work.

QuickTime comes with several software CODECs (compressor/decompressor) to reduce file size while retaining quality. For music, the QDesign Music Compressor is excellent. For speech, the QualComm PureVoice Compressor is a good choice. For video, the H.264 compressor does an impressive job of reducing file size for the visual portion of the video. When used in combination with the QDesign or QualComm audio compressors, file size can be made manageable for transmission over the Internet. A "Fast Start" feature is also available to allow the movie to begin playing while still downloading to the user's computer. The latest version of QuickTime, version 7.1, allows for streaming live content as well.

QuickTime movies can be loaded onto any web server and included in web pages by using the appropriate EMBED code.
<EMBED SRC="doodle16.mov" AUTOPLAY=FALSE WIDTH=150 HEIGHT=24>

For more detailed and advanced editing of video and audio, of course, you might purchase professional software like Adobe® Premiere and Adobe® Audition. Using free and shareware software available from Apple and others, however, you can create multimedia presentations to inspire and educate your students.
Apple QuickTime software can be used to create movies with any combination of video, audio, MIDI data, text, and animations.

**How to Get Started**

To begin working with multimedia sound you will need a multimedia computer with sound input and sound output hardware. Every Apple Macintosh in production today comes with all the necessary hardware and software you will need to begin. On some models, additional hardware such as an external iSight or auxiliary microphone may be required.

A great place to find shareware and freeware audio software for your computer is http://www.shareware.com. QuickTime software and links to other multimedia software can be found at Apple's QuickTime web site, http://www.apple.com/quicktime.
Appendix 4

MULTIMEDIA BASICS: UNDERSTANDING STILL IMAGES
Steven G. Estrella, Ph.D.

What are still images?
Still images are visual representations that do not move. Text is ideal for transmitting information in a highly articulate manner that can be consistently interpreted irrespective of the user. Still images, however, allow the content creator to convey information, which can be more freely interpreted by the user. A picture does indeed paint a thousand words but the meaning of the picture will vary from user to user.

Bit Depth
Pictures are often described in terms of the number of colors found in the image. A simple black and white line drawing is considered to be a 1-bit picture. The word "bit" is a contraction for "binary digit" and refers to a digit in the binary number system. Humans most often use the decimal system in which each digit can have one of 10 values (0 through 9). Computers use the binary system in which each digit can have one of two values (0 or 1), just as one light bulb can represent only two values (on or off). In the binary system a set of two bits (binary digits) can represent four values, just as two light bulbs can represent four values (on-on, on-off, off-off, off-on). The number of values that can be represented increases by a power of 2 with the addition of each bit. The use of more bits per pixel (picture element) adds more color possibilities to an image and increases the file size for the image as well.

Table 1 - Bit Depths and Sample Applications

<table>
<thead>
<tr>
<th>Bits per Pixel</th>
<th>Number of Colors</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>Black and White Drawings</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>Simple Color Icons</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>Simple Color Icons</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>Simple Color Icons</td>
</tr>
<tr>
<td>5</td>
<td>32</td>
<td>Simple Color Icons</td>
</tr>
<tr>
<td>6</td>
<td>64</td>
<td>Color Icons</td>
</tr>
<tr>
<td>7</td>
<td>128</td>
<td>Color Icons</td>
</tr>
<tr>
<td>8</td>
<td>256</td>
<td>Icons, Low-res Photographs</td>
</tr>
<tr>
<td>16</td>
<td>65,536</td>
<td>Photographs, Video</td>
</tr>
<tr>
<td>24</td>
<td>16,777,216</td>
<td>True-color Photographs, Video</td>
</tr>
</tbody>
</table>
**Pixels**

The unit of measurement used for computer graphics is the pixel. The term "pixel" is a contraction for "picture element". A computer screen can be measured in pixels. Most 15-inch monitors today can be set to display a grid of pixels 1024 wide by 768 tall. The horizontal and vertical pixel dimensions are referred to as the resolution. By using smaller pixels, a 15-inch monitor can also be set to display a grid of 1280 by 1024 pixels or more. Larger monitors (17-inch or 20-inch) typically can use these resolutions as well as 1600 by 1200 or larger. When creating a graphic for use on a computer screen, therefore, wise content creators take care to observe the lowest common denominator and avoid creating individual graphics larger than 800 pixels wide and 600 pixels tall. The size of the graphic in pixels and the number of colors found in the graphic are both important factors in the size of the file used to store the image.

**File Formats**

Once created (or acquired through scanning) images can be stored in electronic files on a computer's hard disk, floppy disk, or other electronic storage mechanism. Contemporary graphics software allows the user to save image files in a variety of file formats. One of the most common file formats is encapsulated PostScript (EPS). EPS files are ideal for storing images intended to be printed on high-resolution image setters or laser printers because they store detailed instructions in the PostScript page description language for recreating the image file. A PostScript-equipped image setter or laser printer can then recreate the image at resolutions of 300, 600, 2400, or more dots per inch (dpi). Color PostScript image setters can produce photorealistic output virtually indistinguishable from traditional photographic proofs. EPS is an ideal file format for the production of printed graphics but the appearance of the graphic on screen at 72 dpi is not always impressive. For multimedia applications, screen appearance is very important.

The Macintosh picture format (PICT) is commonly used within multimedia presentations intended to be viewed on a Mac OS compatible computer. PICT files can be read by any Macintosh graphics program or mid to high-end word processor. Images stored as PICT files appear most satisfactory at the 72 dpi resolution used by virtually all computer monitors for display.

The cross-platform file format known as Tagged Information File Format (TIFF) is excellent for both screen display and printed output. TIFF files tend to be larger than equivalent PICT files but they offer greater color fidelity and resolution when printed. The screen appearance, however, is similar. TIFF files are ideal for multimedia presentations intended to be delivered both on the Macintosh and Windows computer platforms.

The Graphic Interchange Format (GIF) is truly universal in its appeal because GIF files can be viewed on Macintosh, Windows, and UNIX platforms. GIF files are compressed to produce a small file size, which makes them very useful for transmitting electronically over the phone lines. As a result, GIF has quickly become the standard file format used for graphics on the World Wide Web. GIF was patented by UniSys in the 1980s and popularized by CompuServe. In 1994, UniSys explored the possibility of charging all GIF developers a fee for creating files in this file format. A brief controversy ensued that threatened to bring a quick halt to the use of graphic files on the web. Fortunately, UniSys decided to create an open license for the use of the
GIF format. Had that not occurred, another file format would have been created to take its place. GIF files are ideal for line art drawings, color icons, and low-resolution photographs. GIF files can also contain multiple images that are viewed in sequence to produce simple animations. Many web sites today exploit GIF files to enliven their pages with animated logos and drawings.

**Graphic Interchange Format**

GIF is the only file format that is understood by 100% of the web browsers in existence. Graphic software like Adobe® Photoshop® or GIFConverter allow users to create GIF files that are optimized to use only the number of colors needed to display the image. GIF files, however, are limited to 256 colors per file, which means that photographs often appear grainy and blotchy.

The Joint Photographic Experts Group (JPEG) file format was designed to store high-resolution photographic images and display them attractively on screen. JPEG is ideal for photographs that must appear as realistic as possible when viewed on a web page. JPEG images can use millions of colors per file and use an efficient though lossy compression algorithm to reduce file size. A photograph stored as a JPEG file will have a smaller file size than the same photograph stored as a GIF file. Oddly though, simple graphics with large patches of solid color or line art often look better when using GIF than when using JPEG. All major web browsers support JPEG although a few older browsers do not.

A JPEG file of my puppy, Clara.
The choice of file format to use for any particular graphic depends on the intended platform and the need for high resolution. For printed materials, EPS is the professional's choice. For traditional multimedia presentations, TIFF has cross-platform appeal but PICT is a better choice for Macintosh-only presentations. For universal appeal on the web, GIF is best for most graphics and JPEG is best for photographs that must be displayed at high-resolution to achieve the desired effect.

**Vector vs. Bitmapped Graphics**

Images used for multimedia presentations are often created or edited in drawing and painting programs.

In drawing programs the user typically uses a tool palette, which contains lines and geometric shapes. The user selects a shape by clicking on it. The user then clicks and drags within the document to create the shape. For example, a user might create a simple rectangle by clicking on the rectangle tool and then clicking and dragging to produce a rectangle within the document. Once created, the rectangle can be filled with colors and/or patterns. Graphic objects created in drawing programs can be individually selected for later editing. Drawing programs support resizing, fill changes, border width changes, and other edits on individual drawing objects. Individual pixels within an object, however, cannot be edited because the object is represented to the computer as a series of vectors rather than a series of pixels. Drawing programs are convenient to use when combining several graphic objects into a layout. In this case the user often prefers to retain the ability to individually select the objects. The layout in figure 1 contains two geometric objects, which can be individually selected and resized to produce the layout in figure 2.

![Figure 1 - two geometric objects created in a drawing program](image1)

![Figure 2 - the same two objects, resized and relayered.](image2)

In painting programs the user also uses a tool palette to select lines and geometric shapes. The user then clicks and drags to place the shape within the document. Once placed, however, the
graphic can only be edited at the pixel level. This poses both advantages and disadvantages. One advantage of pixel level editing is that individual pixels within the object can be deleted or altered. One disadvantage is that an image may appear to contain several distinct objects but the user will be unable to individually select each object for resizing or moving as needed. Painting programs are appropriate in creating and editing individual objects. Painting objects can then be copied and pasted into drawing programs and combined with other objects to produce complex layouts. The layout in figure 3 was created by painting one geometric object on top of another. The two objects can not be individually selected once they are created but the entire graphic can be edited at the pixel level as shown in figure 2.

![Figure 3 - a simple graphic created in a painting program](image1)

![Figure 4 - the same graphic, altered at the pixel level.](image2)

When creating graphics for multimedia it is best to preserve the individual vector objects whenever possible to allow for future editing.

**Acquiring Images**

Very often multimedia authors use preexisting images to enhance their work. Images can be acquired from clip art collections on CD-ROM or through the use of a scanner. Royalty-free clip art collections are commonly available from mail order software stores. The images in these collections are free for you to use in printed and in some cases electronic publications. Check with the manufacturer before you purchase to be sure you are free to use the graphics for your intended purpose. Online stock photography websites, such as the Stock Exchange (http://sxc.hu) are invaluable resources to find free, royalty-free images for non-commercial use.

A scanner can be used to take a digital picture of a photograph or other image and save that image as an electronic file on the computer's hard disk. Using photographs that you have taken is usually legal unless the photograph contains images of children other than your own or other persons who may require a release form before allowing you to publish the photograph. Images scanned from books may be used for educational purposes only if the use complies with "fair use" provisions in the copyright law. In most cases, this means that copyrighted images from
books cannot be placed on web pages or otherwise distributed electronically without the permission of the copyright holder. Graphic images downloaded from web sites should also be used only with the permission of the copyright holder.
Appendix 5

MULTIMEDIA BASICS: UNDERSTANDING MOVING IMAGES
Steven G. Estrella, Ph.D.

What are moving images?
Moving images are an illusion. When we view an animation or video we are viewing a series of still pictures presented in rapid succession. The success of the illusion is dependent on the quality of the individual images and the rate at which they are presented.

Animation
Animations are generally a series of 8-bit graphic images created in a graphics program. The images can then be compiled into an animated GIF file or QuickTime movie file for use in multimedia presentations and on the World Wide Web. Frame rates in animations will vary according to the content. For example, an animation that features type will frequently pause one or more seconds between frames to allow the user to read the type. Animations of moving characters can be successful with frame rates as low as 4 frames per second.

Video
Video can be captured using a standard video recorder and then digitized using video digitizing hardware within a multimedia computer. For video to be effective the frame rate must be at least 10 frames per second and the bit depth of the individual frames must be 16 or greater. The dimensions of the digitized video can be as small as 160 by 120 or as large as 640 by 480 pixels.

Full-screen, full-motion video (including "broadcast quality" video) is said to exist when each frame is 640 pixels wide by 480 pixels tall, each pixel has a color range of 24-bits, and the frames are presented at a rate of about 30 (29.97) per second. The amount of disk space needed to store broadcast-quality video is truly enormous. Using the MiniDV (and accompanying DV compression scheme, a way to reduce, but not eliminate storage issues) medium, 5 minutes of captured raw footage takes up one gigabyte of hard drive space. Many new computers can be configured with secondary hard drives that can be dedicated to video capture. External drives of up to 1 Terabyte (TB: 1,024 Gigabytes) can be purchased and added to a system dynamically.

Fortunately, multimedia video doesn't have to be broadcast quality to be usable. By reducing the grid to 320 by 240 or even 160 by 120, reducing the frame rate to 24 or 15 frames per second, and lowering the color depth (bit depth) to 16-bits for standard video and 8-bits for computer animations, the storage requirements become much more manageable. By using various compression schemes the storage requirements can be even further reduced.
Demonstration 1 - Using Video in Web Pages

MULTIMEDIA BASICS: UNDERSTANDING MOVING IMAGES - Demonstration

Steven G. Estrella, Ph.D.

Demonstration - Using Video and Animation

Demonstrating Instrumental Technique using Video

On a standard soprano recorder, there are two common fingerings for the B above middle C. This movie uses about 714 kilobytes of storage to demonstrate the first fingering.

http://www.ti-me.org/IWP/multamediabasics/fingering1.mov

The second fingering is illustrated through a low-res GIF file (9 k) and a very brief QuickTime movie (282 k).

http://www.ti-me.org/IWP/multamediabasics/fingering2.mov

For even more economy of bandwidth, two GIF files can be placed in a QuickTime movie (42 k) and synchronized with a small MIDI file to produce this animation.

http://www.ti-me.org/IWP/multamediabasics/bc.mov

Demonstrating Non-Musical Activities using Animation

After practicing with the recorder, the recorder should be swabbed to remove excess moisture. The animation below demonstrates the process of separating the sections of the recorder and swabbing out the main body. The entire animation takes only 35 kilobytes of storage.

http://www.ti-me.org/IWP/multamediabasics/swab.gif
Appendix 6

**BLOGS**
Floyd Richmond

One trend that has gained popularity in recent years is the practice of maintaining an online message board known as a blog (short for “web log”). Blogs are mostly text-based but may include other multimedia elements. Blogs may be used for reflective journaling, as a means of publishing an ongoing column, or simply to facilitate communication and discussion. A number of online services offer free blogs. The screen shown immediately below is just one of many templates available at [http://www.blogger.com](http://www.blogger.com). The screen further below shows the form for submitting comments.
Creating a podcast is a simple, four step operation:

1. Record the audio – This can be done with any application that records digital audio or video. The only requirements are that the program be able to save the file as an .m4a, .mp3, .mov, .mp4, .m4v, or .pdf.

2. Post it to the Web and create and upload an RSS feed describing the podcast. For those who wish to do this themselves, see the sample RSS feed below. Further details are found online at [http://www.apple.com/itunes/podcasts/techspecs.html](http://www.apple.com/itunes/podcasts/techspecs.html). A number of web sites simplify this process. According to Apple’s instructions at [http://www.apple.com/support/garageband/podcasts/recording/](http://www.apple.com/support/garageband/podcasts/recording/), you can “Publish your audio file as an enclosure on blogging services such as Blogger ([http://www.blogger.com](http://www.blogger.com))”, then, “create an RSS (Really Simple Syndication) file from your blog. RSS feed providers, such as FeedBurner ([www.feedburner.com](http://www.feedburner.com)), make it easy to create an RSS feed from your blog.

3. Test your podcast. Launch iTunes and from the Advanced menu choose “Subscribe to Podcast”. Enter the URL of your RSS file in the textbox and click ok. iTunes should download your most recent episode to the Podcast playlist. If it does and you can play your latest episode, continue. Otherwise, troubleshoot the steps above until you are successful.

4. Submit the podcast to the iTunes Directory. The following web address should launch iTunes and bring up the page for submitting podcasts. If it does not, you can launch iTunes and navigate to this screen manually (Select Music Store, click Podcasts, click Publish Podcast). [https://phobos.apple.com/WebObjects/MZFinance.woa/wa/publishPodcast](https://phobos.apple.com/WebObjects/MZFinance.woa/wa/publishPodcast)
SAMPLE RSS FILE FOR CREATING A PODCAST

<?xml version="1.0" encoding="UTF-8"?>
<rss xmlns:itunes="http://www.itunes.com/dtds/podcast-1.0.dtd" version="2.0">
  <channel>
    <ttl>60</ttl>
    <title>Your Podcast Show Title</title>
    <link>http://www.yourpodcastwebaddress.com/podcasts/showname/index.html</link>
    <language>en-us</language>
    <copyright>Your Name</copyright>
    <itunes:subtitle>Your Show Subtitle</itunes:subtitle>
    <itunes:author>Your Show Name</itunes:author>
    <itunes:summary>A general summary of your show</itunes:summary>
    <description>A general description of your show</description>
    <itunes:owner>
      <itunes:name>Your Name</itunes:name>
      <itunes:email>YourName@youremail.com</itunes:email>
    </itunes:owner>
    <itunes:image/>
    <itunes:category text="Music"/>
    <itunes:category text="Technology"/>
    <itunes:category text="Music & Technology"/>
  </channel>
  <item>
    <title>Your Podcast Episode 1 Title</title>
    <itunes:author>Your Episode 1 Name</itunes:author>
    <itunes:subtitle>Your Episode 1 Subtitle</itunes:subtitle>
    <itunes:summary>A general summary of episode 1</itunes:summary>
    <enclosure url="http://www.yourpodcastwebaddress.com/podcasts/showname/index.html/episode01name.m4a" length="8727310" type="audio/x-m4a"/>
    <guid>http://www.yourpodcastwebaddress.com/podcasts/archive/aae20060525.m4a</guid>
    <pubDate>Thur, 25 May 2006 7:30:00 EST</pubDate>
    <itunes:duration>28:30</itunes:duration>
    <itunes:keywords>music, technology, podcasting, exciting</itunes:keywords>
  </item>
</rss>
Appendix 8

FINAL CUT PRO OVERVIEW
by Floyd Richmond and Dan Desrosiers, Valley Forge Christian College

When Final Cut Pro launches, a screen similar to the following appears. You’ll notice that there are several editing spaces. Those familiar with Adobe® Premiere®, Flash®, and Director® will notice similarities in the interface.

The first window on the top left is the Browser window. In order to incorporate video, audio, or graphic files into your project, you’ll need to import them into this window. Control-click the window to import the files:

Control-click to add files
Pictures and video files have been added.

NOTE: Final Cut Pro does not import the actual files, rather links to their location on the hard drive. You may want to arrange the files in your hard drive, as well as your project in folders (bins) according to categories.
Once the files to be used have been imported, Final Cut Pro lets you arrange them in any order by dragging them to the Timeline:

NOTE: With the timeline, video footage is typically added in blocks from left to right and transitions (see below) are placed between them. In the window above, there are two audio tracks at the bottom, which play simultaneously and two video tracks, which overlay one another (the text of one appears on the moving images of the other).

The two remaining windows are the Canvas and the Viewer. The Viewer window displays any video that you have double clicked (whether in the Browser window or the Timeline). By selecting the alternate tabs in the Viewer window, you may edit the contents you are viewing. The Canvas graphically displays the current position of the playhead in the timeline.
You may have noticed the tools on the far right of the timeline. These tools are for editing the video. Those in larger fonts are the first you should learn. The bars beside the tool palette are to monitor audio output levels during playback. The palette to the left is the audio meter. Typically, audio for video should rest around -12dB (not as loud as for CDs!).

<table>
<thead>
<tr>
<th>THE TOOL PALETTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selection Tool: Click something on the timeline to select it.</td>
</tr>
<tr>
<td>Edit Selection Tool: Three modes: Edit Selection (default), Group Selection, Range Selection. The default selects an edit point between clips. This is useful if you are going to edit or add transitions.</td>
</tr>
<tr>
<td>Select Track Forward Tool: Four modes for forward, backward, all, etc. It selects all items before or after a specified point.</td>
</tr>
<tr>
<td>Roll Tool: Makes fine adjustments to in and out points of a sequence.</td>
</tr>
<tr>
<td>Slip Tool: Makes fine adjustments to in and out points of a sequence.</td>
</tr>
<tr>
<td>Razor Tool: Divides an existing clip into two parts at a specified point.</td>
</tr>
<tr>
<td>Scrub Tool: Drag forward or backward through the video.</td>
</tr>
<tr>
<td>Crop Tool: Drag the sides of a clip to crop.</td>
</tr>
<tr>
<td>Pen Tool: Adds keyframes and edits volume and panning info, etc. in the Timeline.</td>
</tr>
</tbody>
</table>

Transitions and Effects

When two video clips are placed one after the other, the abrupt change of scene can be unsettling. Filmmakers often soften a scene change with a transition such as a cross dissolve. Cross dissolves merges portions of the two video clips in a manner so that one picture appears to fade out while the other is fading in. Here are the steps for adding a transition.

One important consideration is that both clips on the timeline must be adjacent for an effect to apply to both. Zoom in on the timeline (Command +) so you can see if there is any space. If there is, Control-Click the space and choose “Close Gap.”

Next, with the selection tool, click between the two clips so that the ends of both are selected, as shown here. If the selection doesn’t point in both directions, there is a gap and the transition will not apply to both slides.
Next, in the Browser window, click the “Effects” tab and then open the disclosure triangle beside the “Video Transitions” bin. Choose the desired transition and drag it to the selection on the timeline.

The transition should be added between both clips. Move the playhead before the transition and press play to view the transition.

You may have noticed the several different bins in the Effects tab of the Browser window earlier.

These may be used for performing many kinds of unique effects to the clips and timeline.

- **Video Transitions** add cross dissolves as described above and/or many other transitions (3D transitions, page peels, wipes, iris, stretches, slides, etc.).
- **Video Filters** permit numerous adjustments to the video (blurs, borders, color and brightness correction, perspective changes, etc.)
- **Video Generators** permit the creation of many kinds of content including titles, which overlay the existing movie. Included are generators for color mattes and gradients as well. LiveType and Motion (companion programs) include more extensive options for video generation.
- **Audio Transitions** permit cross fades between audio tracks.
- **Audio Filters** allow the addition of standard audio effects such as equalization, noise removal, and reverb. SoundTrack Pro (a companion program) permits more extensive editing of audio.

When the movie is complete, you’ll want to take it to a program such as iDVD or DVD Studio Pro to burn to DVD. To do this, choose File>Export>QuickTime Movie.
NOTE: To carry the material to another video editing program, especially on another platform such as Windows, you should choose “Using QuickTime Conversion…”

The Final Cut Studio includes several programs.

*LiveType* adds titles with exceptional power. Animated text and backgrounds can be added to projects with ease. Be sure to use transparent backgrounds (represented by a checkerboard) if you want the LiveType text to appear over your movie in Final Cut Pro. Opaque backgrounds are useful if you are designing full screen titles for the movie.

*SoundTrack Pro* contains all of the loops of GarageBand plus full audio-editing functions including the ability to change tempos, keys, and meters in the middle of a song. SoundTrack Pro does not work with MIDI files (convert them to Digital Audio before bringing them into SoundTrack Pro). All loops and samples may be customized using effects, then saved for future use.
Motion is an especially useful for creating introductory and content screens with animations. A 2D animation program, Motion enhances the visual appeal of your project by applying techniques that are not accessible in Final Cut Pro. Motion seamlessly integrates into Final Cut Pro and DVD Studio Pro for title and menu creation.

Compressor is a program that works hand-in-hand with Final Cut Pro for customizing compression settings used for final output. Final Cut offers basic compression through QuickTime Conversion, but Compressor allows much greater codec variety (MPEG-2, MPEG-4, H.264), as well as full parameter control.

DVD Studio Pro is used to create the DVD interface that the user will experience when viewing the finished movie on DVD. Menus contain buttons that link to various portions of your disc. Tracks are video timelines that contain the video assets that you have imported. Each action on your DVD must be specified for what you would like it to do. Buttons must be linked, and you
even have to tell the DVD what to do when it comes to the end of a track! DVD Studio Pro is a powerful program with virtually unlimited customization.

The DVD structure designed above is typical of many commercial projects. It contains the following design:

- Intro – played at the first (Intro Splash, FBI Warning, etc.)
- Main Menu – contains buttons linking to the main movie, scene selection menu and a bonus menu.
- Main Movie – contains the footage edited using the Final Cut family of programs.
- Scene Selection Menu – contains buttons linking to various sections of the main movie and linking back to the main menu.
- Bonus Menu – contains buttons linking to two bonus excerpts and linking back to the main menu.
- Bonus Movie 1 and 2 – contains the bonus movie footage.
Appendix 9

DVD STUDIO PRO OVERVIEW
Floyd Richmond and Dan Desrosiers, Valley Forge Christian College

**DVD Studio Pro** is used to create the DVD interface that the user will experience when viewing the finished movie on DVD. When the program runs, the following screen appears. The screen contains six editing windows, which are described in the text below. From left to right below they are Disc Structure, Viewer, Palette, Asset, Timeline, and Inspector.

As with Final Cut Pro, one of the first steps is to add the video, graphic, and audio files which will be used in the DVD. This is done by importing those files (called assets) into the **Asset** window in the bottom left corner of the screen.

Assets can then be used in the movie in any number of ways. They can be included in a menu as a static graphic or button, or they can be the actual video content to be viewed on the DVD.

To use the assets that you have imported, simply drag them to the place in the movie you wish to use them. (See the information on other windows below)
Click on a file in the *Asset* menu to see it in the *Viewer* window. Some editing may be done in *Viewer* window.

To add a button which links to various portions of the disc simply click and drag in the *Viewer* window. The Button’s text, shape, and target must be set using the *Inspector* window.

Text also may be added by double-clicking anywhere in the *Viewer* (provided you are editing a menu).

The *Timeline* window at the bottom middle of the screen allows users to organize video tracks, as well as set chapter markings.

The *Disc Structure* window in the top left is where the DVD interface is represented in either a graphical or outline view. Menu and Track screens are added by control clicking this window and choosing “Add” from the menu that appears.

| The interface above has a main menu with two choices: play movie and scene selection. | The interface above adds an introduction track, which plays when the DVD is inserted and before the menu is displayed. | The interface above adds a bonus menu and two bonus tracks. |
Disc navigation must be carefully planned in each element of the user interface. Every user operation must be programmed. Links or “targets” from menus to tracks and tracks to menus must be specified. Actions, which occur when the user presses buttons on the remote control, must be added.

Links are added primarily in the **Inspector** window. The **Inspector** window is dynamic and changes depending on what is currently displayed in the **Viewer**. If you double-click on a menu, the **Inspector** window will show several tabs of options for the current menu. It will also provide information and options for buttons, tracks, drop zones, and assets.

![Inspector Window](image1.png)

Each menu or track can have an “end jump” link created in the **Inspector** window on the bottom right of the screen.

The **Inspector** window is also used to set other track parameters such as where to go when the user presses various remote control buttons.

![Palette Window](image2.png)

The **Palette** window in the top right includes numerous templates and other items which can be added to DVD projects.

The button templates are especially useful. Once a button is added, target links are defined in the **Inspector** window.

The DVD may be tested with the Simulate button at the top of the screen and written to DVD with the Burn button.

![Simulate Burn](image3.png)

DVD Studio Pro is a powerful program with virtually unlimited customization options. While iDVD provides templates with much of the capability of DVD Studio Pro, iDVD cannot change specific elements of the interface. With DVD Studio Pro, you have control over every element of the interface.
Camera Basics

- **View Finder** - A small eyepiece or screen on the camera that allows you to see the image you're recording. (The camera also acts as a VCR, so you can play back and watch what you have already recorded through the viewfinder).

- **White Balance** - If you ever ended up with yellow-tinted video, chances are you forgot to white balance. It's worthwhile to white balance every time you use your camera to get the highest quality video. If your camera doesn't have this feature, it may have an automatic or internal system. What white balancing does is adjust the intensity of the colors being recorded according to the existing light. Make sure you white balance every time the lighting conditions change; if you record video inside and then go outside, your lighting conditions have changed and you need to instruct the camera on how to "see" the colors. How do you white balance? You can place a piece of white paper under the light you will shoot under for reference - focus on the paper in the view finder, and press the "White Balance" button. Or you can focus on someone's white T-shirt (make sure it's all white). Or, your camera may have an automatic white balance setting you can use by simply adjusting a switch or pressing a button. WarmCards are used to “warm balance” the camera, or trick it into thinking there is a bluer tint to the light, thus adding more reds and yellows. This will look “warmer” or more inviting to the brain.

- **CCD** – stands for “Charged Coupled Device” and is the way that analog light gets converted to an electrical signal that is sent through processing onto tape. Consumer cameras have 1 CCD that is responsible for RGB light, whereas professional cameras have 1 CCD per color of light. This allows for greater color resolution and a much better picture.

- **Battery** - power source. Make certain you charge them!

- **Focus** - There are two ways to focus - auto and manual. When you focus in "manual", you control the focus. To make sure your shots are in focus, zoom in and focus up close first, then zoom back. This insures that what you are shooting is focused to the greatest extent possible. Manual focus is good to use when there is a lot of movement of dominant figures. When the camera is in "auto focus" it will automatically focus on the dominant figure in the center of the viewfinder. Because it focuses automatically on the dominant figure, it will adjust to whatever becomes dominant. For example, if you are focused on a person several feet away, and someone walks in between the camera and the other person, the camera will adjust to focus on the new dominant figure - the person who walked in front of the camera.

- **Iris** – measured with an “F” followed by a number, this function of all photographic capturing devices opens and closes the aperture of the iris. All the light coming into a camera is through a tiny hole, and the aperture is how wide that hole actually is. The
higher the number is, the smaller the hole. F16 is the least amount of light that the iris can allow into the CCD. F1.6 or 1.8 are some of the widest apertures that you will see.

- **Depth of Field** – Depth of field corresponds directly to your positioning to the subject, as well as the F-stop. A *shallow* depth of field is exemplified by a subject in the frame with a blurred background. The opposite of that is a landscape where just about everything from the foreground to the background is in focus at the same time.

- **Shutter Speed** – this is another way to control the amount of light that enters the CCD on the camera. The value is a 1/ with another number following. The first number represents one second, and the second number is how many times the shutter is opening and closing in the course of that second. The higher the second number, the faster the shutter is moving, thus less light gets let into the CCD.

- **Gain** - this increases light sensitivity for recording in dim conditions. Often results in "grainy" or discolored video when used in low light situations. Measured in decibels (dB).

- **Over exposure** – what happens when there is too much light coming into the CCD. Bright spots on the screen have no detail and are “blown out,” meaning large spots are being represented by the highest possible value of white.

- **Stand by** - the electrical equivalent of a "pause" button. This is often faster than powering off and restarting the camera, as internal components have already been initialized.

- **Time Code** - this is a number (could be seconds or frames) that helps you determine where scenes are located on videotape. You will see this when you look through your viewfinder. You can use this when logging your tape and editing.

- **Frame** - a single, complete video image that lasts 1/30th of a second. There are 30 frames in a second. If your camera or editing system can measure frames, you can use this as a counter to log your videotape.

- **B-roll** - this refers to certain video you collect. B-roll is any video that isn't the main action; video that illustrates or shows examples. You might think of it as Background-roll. For example, if you are interviewing someone and they're talking about the Golden Gate Bridge, you might then show video of the Golden Gate Bridge (after they are talking, or while they are talking). This is called B-roll. (And no, there is no A-roll).

- **NTSC** – “National Television Systems Committee” and the name of the current analog transmission standard used in the US, which the committee created many decades ago. The standard in the US is 525 lines of resolution, that refreshes at 60 cycles per second or Hertz (Hz).

- **Interlacing** – how an NTSC monitor refreshes. The monitor refreshes every other line 30 times a second. Starting with the upper left-hand corner going down and to the right, the lines that are refreshed are ½ second apart, but because they are interlaced so fast, they appear to be one image.

- **60i/30p/24p/Frame Mode** – These controls and the terminology used to describe this concept has a small level of variance, but the concept is the same. On the simplest level, some cameras (Panasonics and XL1s) have “Frame mode” that looks markedly different
from “Normal mode.” In normal mode, the camera sends interlaced data to the tape, at 60 interlaced fields per second. 30p mode is also called “frame mode,” and sends 30 frames per second, also called “progressive” in some DVD players. 24p is how film is shot, and some DV cameras emulate this by shooting 24 frames progressive per second. This is a very unique look, and can have issues in some settings, but is not easily emulated with non-24p cameras.
Tape Formats

- **VHS** – Vertical Helical Scan (or as JVC calls it, "Video Home System"). Widely used method of recording audio and video electrical signals onto magnetic tape, at about 250 lines of resolution. Released in 1976, this format was widely used until the wide acceptance of DVDs in the mid-1990s.

- **SVHS** – Super-VHS. A higher quality version of the VHS videotape format. Separates chrominance (color) and luminance (brightness) information to produce a sharper picture than regular VHS videotape. In SVHS, the resolution was improved to about 400 lines.

- **VHS-C** – or VHS-Compact, a smaller cassette in which the VHS magnetic tape is stored. Due to the smaller size, less tape could be stored, thus a shorter record time. Also available in SVHS-C.

- **8mm** – A compact consumer videocassette record/playback tape format utilizing eight-millimeter wide magnetic tape. A worldwide standard established by Sony in 1983, the small size of the cassette made the palm-sized camcorder a reality. Hi-8 is a format offshoot that increases the horizontal video resolution to over 400 lines, improving reproduced picture quality, sharpness and detail. The two formats are incompatible although Hi-8 equipment can record and play standard 8mm tapes.

- **Digital8** – Recording digital video onto standard 8mm or Hi8 tapes, this digital video standard was developed by Sony in the late 90s.

- **DV** – The abbreviation for Digital Video, specifically applied to a common video format that encodes video digitally onto tapes. Related formats include: MiniDV, DVCPRO, and DVCAM. DV decks can be connected to a computer using an IEEE-1394 (FireWire) connection. Unlike analog format which is an electronic signal that loses effectively every time the video signal is duplicated. DV format suffer no loss of quality when you duplicate video sources. At a resolution of 720x480 and 29.97 fps, DV consumes 1GB of space for roughly 5 minutes of tape.

- **DVD** – Digital Versatile Disc (*not* Digital Video Disc). Single-layer DVDs can hold 4.7GB of information. Dual-layer discs, now becoming available to consumers, can hold 8.5GB of information. New technology in DVD includes HD-DVD and BluRay DVDs. BluRay discs can hold 25GB per layer, and the less expensive HD discs can hold 15GB per layer.
Microphones

- **On Camera Mic** - this is built on the camera. This small microphone can be housed inside the casing of the camera on consumer models, or outside/removable on prosumer cameras. Some on camera mics are “omni-directional,” meaning they will pick up sounds from all directions. This is good to use to capture general audio from an event, but nothing very specific. Since the microphone is closer to you than to your subject, be careful - if you're talking, your voice will dominate.

- **Lavaliere Mic** - this is a small microphone that can be clipped onto a piece of clothing. Lapel mics, as they can be called, can be wired or wireless. They are good to use to capture the sound of the speaker. They are generally used when the speaker is moving around, versus sitting still or standing at a podium.

- **Handheld Mic** - this is a microphone, wired or wireless, that picks up sound very close to it. Handheld mics are very directional, as well as have proximity issues, meaning the mic must be in close proximity to the source in order to pick up the sound accurately.

- **Shotgun Mic** - This long, narrow microphone is designed to pick up sound that is far away. For example, if some people are 30 feet away, and you want to hear what they are saying, point this microphone directly at them. The range of the microphone will vary. A variation of this is called the *parabolic* mic that has a reflector that focuses the sound from great distances to a single point.
Connections

- **S-Video** – 4-pin cable that transmits separate chrominance and luminance signals, like a compact component cable.
- **BNC** – signal connector featuring a twist-locking motion.
- **Composite** – Also called RCA connectors, the yellow color delineates video, and red and white represent right and left audio.
- **Component** – A signal that's recorded or transmitted in its separate components. Typically refers to Y/Pb/Pr, which consists of three 75-ohm channels: one for luminance information, and two for color. Compared with an S-video signal, a Y/Pb/Pr signal carries more color detail.
- **RGB (“Computer”)** – Also called VGA, RGB is the basic additive process that produces color information on a computer or projector display.
- **XLR** – Xtended Locking Round. XLRs are rugged, locking, multi-pin connectors frequently used in pro audio equipment. While 3-pin XLRs are most commonly seen on microphones and console inputs, other configurations also exist, such as 4-pin XLRs (a standard for stage intercom systems) and 5-pin XLRs (often used on stereo microphones).
- **1/8” (Mini Plug) Stereo** – Used commonly on headphones, this connection carries a stereo (L+R) signal.
- **Quarter-Inch (1/4”)** – 1/4” in diameter, this cable is mono, and is usually used for instruments and speakers.
- **1/4” TRS** – A professional version of the stereo mini-plug, the TRS (Tip-Ring-Sleeve) connector is also called balanced.
- **FireWire (IEEE-1394)** – Apple's trademark name for the IEEE 1394 standard. FireWire is a fast and versatile interface used to connect DV cameras to computers. FireWire is well suited to applications that move large amounts of data, and can also be used to connect hard disks, scanners, and other kinds of computer peripherals. The speed of FireWire is about 400Mbps.
- **USB 2.0** – a faster variant of the Universal Serial Bus. USB devices can be hot-swapped (plugged in and taken out without shutting down the computer), and the 2.0 transfer speeds are at around 480Mbps.
- **RJ-45** – Ethernet (computer network or LAN) connection that can be used in many scenarios utilizing twisted pair cable. Guitar processors, in-ear monitoring systems, and other, various, non-computer related venues can utilize the RJ-45 connection.
Camera Operation

- **Pan** - A shot taken moving on a horizontal plane (from left to right, right to left).
- **Tilt** - Camera movement in a vertical plane. (up or down)
- **Zoom** - This shot brings you closer to the subject, also called a “push.”
- **Reverse Zoom** - This shot moves you farther away from the subject, also called a “pull”
Video Production

- **Project** – Each complete video should be a project. A project contains sequences, bins, and video elements. Everything you do in a given video is contained in the project, and your project is the file you open with FCP.

- **Timeline** – The timeline functions as the foundation of video editing. Clips are inserted, layered, and composited in the timeline to produce the final video product. The timeline is quantified in hours/minutes/seconds/frames (remember there are roughly 30 frames per second in DV).

- **Composite** – An amalgamation of video assets layered together to produce a final shot.

- **Capture** – The process by which video is transferred from an outside source to the computer hard drive. In DV, data is transferred via FireWire (IEEE1394) to the host computer. If the video being captured is on media other than a DV tape, it must be run through an A/D (Analog to Digital) Converter. This will convert the signal coming into the box to a DV signal that can then be captured to the computer. A/D converters are also available as internal capture cards on desktop computers.

- **Browser** – The Browser is where you organize all of the project elements you use when editing. You can view the different elements as a list or icons.

- **Bin** – A bin is essentially a folder contained in the current project that is used to organize assets that have been imported. The actual files are not stored in the bins themselves; rather, they contain links to outside files. When the linked files are modified, the bin item will change, and will not have to be reimported.

- **Viewer** – The Viewer is where you view your source material and choose edit points. But you can also edit audio, modify transitions and effects, and build titles here.

- **Canvas** – The Canvas and Timeline windows are different sides of the same coin. Both display your edited project, but whereas the Timeline shows your editing choices graphically, the Canvas displays those edits visually like a movie.

- **Tool Palette** – The Tool palette is a collection of Final Cut Pro editing.

- **Audio Meters** – The audio meters window displays two audio meters that reflect the volume level of whatever audio is playing. It could be a source clip in the Viewer you screen before editing or the final piece you view in the Canvas.

- **Clip** – Each clip in your project represents some portion of your original captured source footage. It links back to a digital media file on your hard drive.

- **Sequence** – A sequence is a group of audio and video clips that have been edited together. A sequence might also contain effects and transitions you may have applied to the edited clips.
• **Playhead** – In the Timeline, blue video and green audio clips sit on horizontal tracks. These tracks are a linear representation of time proceeding from left to right. In the middle of the current sequence is a thin vertical bar with a yellow triangle at the top. This is the playhead.

• **Razor Blade** – The razor blade tool is used to cut clips in your timeline. It is another very accurate way to edit in/out points.

• **Gap** – Spaces in the timeline between clips that contain no footage. These will appear as black in the Canvas window.

• **Ripple Delete** – A control+click function, ripple delete eliminates gaps in your timeline, while shifting material to the left.

• **Rubber Band** – The graphical representations of key frames, rubber bands show changes in values, from opacity to volume to velocity.

• **Keyframe** – Marks a change in value from one point in time to the next. For example, a fade-in would have a keyframe at 0%, then another at 100% at a following point in time. The result is the computer interpolates the values in between, providing a smooth fade.

• **Clipping (audio)** – Caused when too much signal is attempting to be outputted, clipping audio is one of the worst things that can happen in audio. Clipping audio is represented in two ways: On the audio meter, the VU goes all the way to the top, red portion, and the meter reads “clip.” Secondly, audibly, clipping audio can be discerned when the audio is hard to understand, has no dynamic range, and has high pitched white noise attributed to it.

• **Transition** – A way to transition between two clips, a transition is an effect that is used in video production. Dissolves, wipes, and 3D transitions are all ways to go to B-roll. In professional video production, standard cross dissolves and straight cuts are most often used. The occasional wipe can be found along with intense, boutique transitions that are professionally, and expensively made.

• **Filter** – A filter is a way to alter the clip that it is applied to. Filters can range from color correction to distortion to manipulation of the clip itself. Multiple filters can be applied to a single clip, and when used properly, are extremely powerful to a video editor.

• **Color Matte** – A clip that is a single solid color.

• **Title** – A way to put text on the screen, a title can be full-screen, upper third, or most commonly, lower third. Titles are used to identify the individuals on screen or for any variety of venues that visual reinforcement is needed.

• **Aspect Ratio** – The ratio of pixels on a screen, wide vs. high. A typical television set has an aspect ratio of 4:3; it is 3 pixels high for every 4 that it is wide. New widescreen HDTV sets have an aspect ratio of 16:9.

• **Codec** – Stands for compressor/decompressor. Codecs are the Rosetta Stone of video. If a video is encoded in a DV codec, the device attempting to play it must also have the DV codec installed. Each codec has a multitude of different options and configurations, including size of frame, compression ratio, audio options, and the generic “quality.”
Some common codecs are: Cinepak, Microsoft Video 1, Windows Media Video, H.264, DivX ;-), and MPEG-2.

- **Compression** – Compression is the way that information on video is squeezed to be able to fit in different delivery systems. A 2 hour long DV AVI video that is 40GB in size must be compressed to fit on a 4.7GB DVD. The MPEG-2 codec to compress DVD video because it retains much of the original information, and provides a maximum viewing experience in a minimum of storage space.

- **Lossy Compression** – Especially found in online delivery, lossy compression is compression that has a much lower quality than the original. Blocks, digital noise, garbling audio, and artifacting are all telltale signs of lossy compression. Much of the original information contained in the source file is lost with lossy compression.
File Formats

- **AVI** – a native Windows format, AVI or Audio Video Interleave is currently the most popular video distribution format on the PC. It contains both audio and video, and can be encoded using a multitude of *codecs*.

- **MPEG** - A lossy, high-quality codec. Comes in several flavors. MPEG-1 is used for the VCD format, MPEG-2 is used for DVD format video. Both flavors are suitable for distribution of full-motion, full-frame video. MPEG-3 or MP3 is a popular audio format, whereas MPEG-4 is widely used for video distribution both on the Internet and cell phones.

- **MOV** – a native Mac format, MOV or QuickTime Movie is similar to the AVI format for Windows. It can contain video and audio or either of the two media. MOV files can also be encoded using a number of codecs, appropriated by the application.

- **WMV** – or Windows Media Video. As the name implies, WMV files can only be played using Microsoft’s Windows Media Player. This file format is used for Internet distribution mostly, although distribution of Hi-Def content has been known to use the WMV format (Terminator 3 SE).

- **RAM** – Real Audio Media can only be played using the proprietary RealNetworks Players. Real became popular when streaming audio first hit the Internet scene, which is the format’s forte. However, a heavy player and buggy file format have been this dying format’s demise.
## TI:ME 2B Preparing Digital Media

### Possible Schedule

<table>
<thead>
<tr>
<th>Class</th>
<th>Time</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Day One</strong></td>
<td></td>
<td><strong>Morning Sessions</strong></td>
</tr>
<tr>
<td>Class 1</td>
<td>9:00 – 9:30 AM</td>
<td>Orientation – TI:ME Info</td>
</tr>
<tr>
<td>Class 2</td>
<td>9:45 –10:30 AM</td>
<td>Digital Media Overview</td>
</tr>
<tr>
<td>Class 3</td>
<td>10:45 – 12:00 AM</td>
<td>Digital Imaging Part I – capture &amp; import</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Afternoon Sessions</strong></td>
</tr>
<tr>
<td>Class 4</td>
<td>1:15 – 2:45 PM</td>
<td>Digital Imaging Part II - Photoshop®</td>
</tr>
<tr>
<td>Class 5</td>
<td>3:00 – 4:00 PM</td>
<td>National Standards &amp; Digital Media</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Lab Hours 4:15 – 7:00 Room 218</em></td>
</tr>
<tr>
<td><strong>Day Two</strong></td>
<td></td>
<td><strong>Morning Session</strong></td>
</tr>
<tr>
<td>Class 1</td>
<td>9:00 – 10:00</td>
<td>Digital Imaging Part III – Photoshop® 2</td>
</tr>
<tr>
<td>Class 2</td>
<td>10:15 – 11:00</td>
<td>Digital Imaging Part IV – exporting</td>
</tr>
<tr>
<td>Class 3</td>
<td>11:15 – 12:00</td>
<td>Using Digital Images in Multimedia</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Afternoon Sessions</strong></td>
</tr>
<tr>
<td>Class 3</td>
<td>1:15 – 2:15</td>
<td>Graphics &amp; Text</td>
</tr>
<tr>
<td>Class 4</td>
<td>2:30 – 3:45</td>
<td>Simple Graphic Animation</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Lab Hours 4:15 – 9:00</em></td>
</tr>
<tr>
<td><strong>Day Three</strong></td>
<td></td>
<td><strong>Morning Session</strong></td>
</tr>
<tr>
<td>Class 1</td>
<td>9:00 – 10:00</td>
<td>Digital Audio I</td>
</tr>
<tr>
<td>Class 2</td>
<td>10:15 – 11:00</td>
<td>Digital Audio II</td>
</tr>
<tr>
<td>Class 3</td>
<td>11:15 – 12:00</td>
<td>Digitizing MIDI files</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Afternoon Sessions</strong></td>
</tr>
<tr>
<td>Class 3</td>
<td>1:00 – 2:30</td>
<td>Audio &amp; Digital Video</td>
</tr>
<tr>
<td>Class 4</td>
<td>2:45 – 3:45</td>
<td>Copyright Issues in Digital Media</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Lab Hours 4:15 – 9:00</em></td>
</tr>
<tr>
<td><strong>Day Four</strong></td>
<td></td>
<td><strong>Morning Session</strong></td>
</tr>
<tr>
<td>Class 1</td>
<td>9:00 – 10:00</td>
<td>Digital Video I</td>
</tr>
<tr>
<td>Class 2</td>
<td>10:15 – 11:00</td>
<td>Digital Video II</td>
</tr>
<tr>
<td>Class 3</td>
<td>11:15 – 12:00</td>
<td>Digital Video III</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Afternoon Sessions</strong></td>
</tr>
<tr>
<td>Class 3</td>
<td>1:00 – 2:15</td>
<td>Blogs &amp; Podcasts</td>
</tr>
<tr>
<td>Class 4</td>
<td>2:30 – 3:45</td>
<td>Creating DVD’s</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Lab Hours 4:15 – 10:00</em></td>
</tr>
<tr>
<td><strong>Day Five</strong></td>
<td></td>
<td><strong>Morning Sessions</strong></td>
</tr>
<tr>
<td>Class 1</td>
<td>9:00 – 10:00</td>
<td>2C Strategies For The Classroom</td>
</tr>
<tr>
<td>Class 2</td>
<td>10:00 –12:00</td>
<td>Guided Labs</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Afternoon Sessions</strong></td>
</tr>
<tr>
<td>Class 3</td>
<td>1:00 – 2:00</td>
<td>Presentation of Projects</td>
</tr>
<tr>
<td>Class 4</td>
<td>2:00</td>
<td>Wrap-up</td>
</tr>
</tbody>
</table>