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Digital Media (TI:ME 2B)
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• Text
• Graphics
• Sound
• Video

Description
Digital Media (TI:ME 2B) covers the creation of multimedia files which may be integrated into internet and multimedia projects, computer programs, or which may stand alone as educational products (videos, CDs, audio tapes, etc.). Inservice teachers (ISTs) 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. This course may be taken separately or its content may be integrated into other TI:ME courses.

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 IST 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 required. Each participant must have access to a private workstation consisting of a multimedia-capable computer, MIDI keyboard, and audio and video support equipment. The teachers 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 ISTs in basic skills in creating instructional multimedia. The instructor will also provide ISTs 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 which incorporates multimedia files into a larger project would also be helpful.

**Objectives**

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

**Procedural Knowledge**
The IST 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 IST completes the class worksheets on creating multimedia. The IST 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 IST will open existing multimedia files such as pictures of instruments, composers, or recordings which illustrate musical concepts.
The IST will explain how these materials may be integrated into the teaching of various music classes (band, orchestra, choir, general music, etc.)
The IST will complete worksheet #1 on the different types of multimedia files.

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**Topic #2 - Multimedia - Text 1**

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.

Class Activities #2
The IST will enter text into a multimedia presentation program using various fonts, styles, and sizes.
The IST will save the document in various text formats (TXT, RTF, PDF, HTML).
The IST will complete worksheet #2 on the different types of text files.

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**Topic #3 - Multimedia - Text 2**

THE INSTRUCTOR WILL DEMONSTRATE OPTICAL CHARACTER RECOGNITION (OCR) USING A SCANNED PICTURE OF TEXT AND A TEXT RECOGNITION PROGRAM. THE INSTRUCTOR WILL DEMONSTRATE HOW TO CREATE A PDF FILE.

Class Activities #3
THE IST WILL CONVERT A SCANNED PICTURE OF TEXT TO A TEXT FILE USING OCR SOFTWARE.
THE IST WILL CREATE A CROSS-PLATFORM PDF FILE.
THE IST WILL COMPLETE WORKSHEET #3.

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**Topic #4 - 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, BMP, PICT, TIFF, etc.)

Class Activities #4
The IST will add existing graphics to a multimedia presentation program. The IST will complete worksheet #4.

**Topic #5 - Multimedia - Graphics - Using 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 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 #5**
- The IST will open and crop an existing image.
- The IST will open and correct color and brightness settings in a photograph.
- The IST will convert a color picture to grayscale or black and white.
- The IST will resize an existing picture.
- The IST will create draw a simple picture (stick figure or better) using the tools of a painting/drawing program.
- The IST will save or convert work to an appropriate graphic file.
- The IST will complete worksheet #5.

**Topic #6 - Graphics - Scanning a Picture**

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.

**Class Activity #6**
- ISTs 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 IST will complete worksheet #6.

**Topic #7 - Graphics - Using a Digital Camera**

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 Activity #7**
- ISTs will take pictures of each other using a digital camera. ISTs will download the photographs from their camera to the computer. ISTs will complete worksheet #7.

**Topic #8 - Graphics - Simple Animation**

The instructor will explain basic techniques for creating animations. The instructor will explain file formats such as gif, and mov which may contain animations.
Class Activity #8
ISTs will create simple animations illustrating musical concepts using a drawing and painting program and save or convert the figures to an appropriate file. ISTs will complete worksheet #8.

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**Topic #9 - 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 ECHO OR REVERB.** The instructor will demonstrate the process for saving or converting the sound file to an appropriate format.

Class Activity #9
The IST will add existing sounds to a multimedia presentation program.
ISTs will record themselves counting to four.
ISTs will cut and paste the numbers so that they count backwards.
ISTs will save the recording and convert it to a wav file.
ISTs will create an audio file which illustrates a musical concept and is appropriate for use in the music classroom.
ISTs will complete worksheet #9.

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**Topic #10 - 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.

Class Activity #10
The IST will add existing MIDI files to a multimedia presentation program.
The IST will open a standard MIDI file and perform a variety of edits.
The IST will then save the file in a variety of formats (type 1, type 0).
The IST will discuss why different music file formats exist, compare files sizes for the same information and postulate what information is different between the files.
The IST will complete worksheet #10.

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**Topic #11 - 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 how to convert “talking head” video into more compact structures (one or two frames per second). 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.
Class Activity #11
The IST will add existing video files to a multimedia presentation program. ISTs will record a video of themselves saying, "hello! Welcome to my multimedia project." ISTs will save the recording and convert it to a mov file. The IST 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. ISTs will complete worksheet #11.

**Topic #12 - 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 Activity #12
The IST will participate in a discussion on copyright issues and will complete a worksheet on the topic. The IST will complete worksheet #12.

**Topic #13 - Curriculum Integration**

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

Class Activity #13
The IST will participate in a discussion on curriculum integration and will complete worksheet #13.

**Topic #14 - 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 #14
The IST will design and create a web page for use in a music class. The IST will complete worksheet #14.
1. Describe the elements of multimedia.

   a. **Text** [Text equals words. Although multimedia is a graphically rich environment, much of its meaning would be lost without the words which give specific instruction and content.]

   b. **Graphics** - [Graphics are pictures. Pictures are used to illustrate points, display music notation or to add beauty.]

   c. **Sounds** - [Sounds in multimedia projects are primarily digital recordings of sounds.]

   d. **MIDI files** - [MIDI files are the files generated by sequencing or notation programs. These files contain instructions for playing music on an external device such as a synthesizer or sound card. MIDI files are quite compact but they do not contain digital recordings of specific sounds.]

   e. **Movies** - [Movies are digital recordings much like video tape.]

2. Comment on the various types of multimedia files.

   Text:
   - TXT _________________________________
   - HTM _________________________________
   - PDF _________________________________
   - RTF _________________________________

   Graphics:
   - GIF _________________________________
   - JPG _________________________________

   Animations:
   - GIF _________________________________

   Sounds:
   - WAV _________________________________
   - AIF _________________________________
   - AU _________________________________

   MIDI:
   - MID _________________________________

   Movies:
   - MOV _________________________________
Digital Media
TEACHER WORKSHEET 2
Text 1

1. List tips for the effective use of text in multimedia presentations.
   [Use text for explanations, instructions and labels.
   Match the reading level of the text to the intended audience.
   Present ideas logically and sequentially. Don’t skip procedural steps.
   Show the organization of superordinate and subordinate ideas through the use of titles,
   spacing, style and color of text.
   Avoid “too much” text.
   Check spelling, punctuation, and grammar.]

2. How does one enter text into a presentation program.
   [If necessary, create a field into which to enter the text. Click where desired. Type the text.
   Press return to add space between paragraphs. Select the text and choose the desired color,
   style, size, justification, etc. from the toolbar.]

3. Comment on each of the following text files. How does one open or view the following files.
   TXT
   [TXT files contain words only. They do not contain formatting (centering,
   margins, justification, text styles, etc.). Open with any internet browser, text editor,
   or word processor]

   HTML
   [HTML files are text files which are used extensively on the internet. HTML files
   contain text, instructions for formatting the text, and instructions for displaying graphics,
   sounds, and video. HTML files may contain links to other information.
   Open with any internet browser.]

   PDF
   [PDF files are cross-platform files created with Adobe Acrobat. Because the files
   display virtually the same on every computer regardless of the fonts installed or the
   operating system, they are quite popular on the internet. PDF files may contain
   formatted text, graphics and links to other information. Open with Adobe Acrobat,
   Adobe Acrobat Reader, or with any browser which has Adobe’s PDF plug-in installed.]

   RTF
   [RTF files may contain formatted and stylized text and graphics.
   Open with Microsoft Word or any word processor which can read RTF files.]
1. How does one convert a paper containing text into a text file?

   [Method 1 Retype the material into the computer using a word processor. Save it as a text file.]

   [Method 2 Create a picture of the paper on the computer using a scanner and appropriate software. If necessary, run the character recognition program and convert the picture to text. Proof the newly converted file for errors. Save as a text file. Remember, good typist may find method 1 to be faster, especially if the copy is bad or the text is short.]

2. How does one create a PDF file?

   [Anyone can read a PDF file using Adobe’s free Acrobat Reader. To create a PDF file, however, requires Adobe’s Acrobat or a similar product. This software typically comes with a printer driver which, when selected, writes a PDF file when a document is printed. Since the software is in the form of a printer driver, any computer program which can print (word processor, internet browser, painting program, etc.) may be used to create a PDF file.]
Digital Media

TEACHER WORKSHEET 4A

Graphics

1. Why would one use graphics in a multimedia presentation?
   [To enhance meaning and add information.]

2. How does one enter graphics into a presentation program.
   Method 1: Use the presentation program’s drawing tools to create the necessary drawing.
   Method 2: Copy a clip art graphic and paste it into place.
   Method 3: Choose “Insert” or “Import” from the program’s menus and place an existing graphic file.

3. How does one create images with a drawing program?
   [Run the program, use the drawing tools to create the desired image, save or convert the picture to an appropriate file format.]

4. How does one create images with a scanner?
   **BASIC:** [Run the scanning program. Place the image on the scanner. Press the preview button. Select the portion of the page to be scanned. Press the scan button. Save the image in an appropriate format.]
   **DETAILED:** Run the scanning program. Place the image on the scanner. Press the preview button. Select the portion of the page to be scanned. Set the scan resolution (dots-per-inch) to an appropriate setting. For multimedia presentations which will be displayed on a computer monitor 72 dots per inch is best. For materials which will be printed, the resolution of the printer (usually 300 to 1200 dots per inch) is best. The the color depth should also be set to match the resolution of the image and the display device. Set the color depth to black and white for line drawings, 256 colors for animations and most photographs, or thousands for very colorful or large photographs. Also, set the brightness and color controls as desired. Scan the image and save or convert it to an appropriate file format.

5. How does one create images with a digital camera?
   [Take the picture with the camera, connect the camera to the computer, run the software which came with the camera, download the pictures to the computer, save or convert the pictures to an appropriate format.]

6. How does one create notation for use in a multimedia presentation?
   [Screen capture is the best method for preparing notation for multimedia presentations. Mac users may capture notation displayed on the screen by typing Apple-Shift-3. The notation is saved to a PICT file on the hard drive. These files may be opened with SimpleText by double clicking them. The portion of the screen with the notation may be selected, copied, and pasted into multimedia software. IBM users may capture the screen with the “Print Screen” button (and a modifier key, if desired). The resulting file may be opened with Paint and the desired notation selected, copied, and pasted into multimedia software.]

7. What are the advantages and disadvantages of various graphic file formats (GIF, JPG, BMP, PICT, TIFF)?
   **GIF** Advantages: GIF is a universal internet format. It works well with cartoon like drawings and most photographs. GIFs display well on virtually all color monitors. GIF files also support animations. Disadvantages: GIFs support only 256 colors.
   **JPG** Advantages: JPG is a universal internet format. It works well with colorful and large photographs. JPGs display well on all modern color monitors. Disadvantages: JPGs save more color information and larger photographs by compressing them. Sometimes loss of quality occurs.
   **BMP** Advantages: BMP is a common format on Windows compatible computers. It is supported by virtually all Windows drawing or painting programs. Disadvantages: BMP is not as well supported on non-Windows operating systems.
   **PICT** Advantages: PICT files are common on Macintosh compatible computers. Support for creating, editing and saving them are built into the Macintosh’s operating system so they are supported by virtually every Macintosh drawing or painting program. Disadvantages: PICT files are not well supported on non-Macintosh operating systems.
   **TIFF** Advantages: TIFF files are supported by most scanning programs on Macintosh or Windows platforms. Disadvantages: TIFF files include a number of sub-types which are not supported in all programs.
1. How does one import a graphic file into a drawing program.
   [Choose Open or Import from the File menu.]

2. How does one crop an image in a drawing program?
   [This varies from program to program. Generally, the part of the image to be kept is selected and “Trim” or “Crop” is chosen from one of the menus. In some cases, the document size must be reset. In some cases, it is easier to copy and paste the desired portion of the image into a new document.]

3. How does one correct color and brightness settings in a photograph?
   [Many drawing programs have options which allow the brightness and color to be changed. Typically a menu option offers a dialog box with sliders which can be moved as desired. Typically before and after versions of the image are visible on the screen simultaneously.]

4. How does one convert a color photograph to gray scale or black and white?
   [Many drawing programs have an option which allows a color photograph to be converted to grayscale. Grayscale images have the advantage of displaying well on more monitors than color images. Black and white images resemble grayscale images but are different in that every pixel of the image is either black or white. Each pixel in a grayscale image may be any one of several shades of gray. Black and white photographs mimic grayscale by mixing white and black pixels together. Programs which convert color or grayscale images to black and white usually offer a few different “dithering” routines by which the different shades of color are imitated. It is best to experiment with several different “dithering” options when possible. Additionally some programs which convert images to black and white offer “threshold” conversion in which every pixel brighter than a given quantity is turned white and every pixel darker than that quantity is turned black. This type of conversion works well for line drawings but poorly for photographs.]

5. How does one resize an existing picture?
   [Select the image or portion to be resized. Choose “Scale” or “Resize” from one of the program menus and specify the percentage by which the image should be resized. When resizing images, the following percentages usually give the best results (Enlargements: 200%, 300%, 400%, etc., Reductions: 50%, 25%, 10%) Images that are made larger are never as sharp as the original since each pixel is enlarged to a bigger square. Images that are made smaller sometimes look good but lose detail. Depending on how the program handles the graphic data, a reduced picture MAY not be able to be enlarged again. Pictures may usually be scaled or resized in two directions: horizontal or vertical. Typically pictures will be resized “proportionately” in both directions, Using different horizontal and vertical values, however, creates some interesting effects. Tall, thin people may be made to appear short and fat and vice versa. Text, also may be made to appear tall and thin or short and fat.

6. How does one draw a simple picture (stick figure or better) using the tools of a painting/drawing program.
   [Run the program, use the pencil, brush, line, shape, eraser, and other tool.]

7. How does one copy and paste a portion of a picture.
   [Use one of the program’s selection tools. From the Edit menu, choose “Copy”, Move to the desired location for the picture. From the Edit menu, Choose “Paste”. Move the graphic so that it is exactly where it needs to be. The program will typically offer a number of selection tools. One usually simplifies selecting a perfect rectangle, oval, or other shape from the picture. There is also usually a lasso tool which allows a custom portion of a photograph to be selected, copied, and pasted.]

8. How does one add a custom background and or texture to a picture.
   [Most painting programs offer a “Paint Bucket” tool which is capable of filling a specified area with a selected texture or background.]

9. How does one save a picture to an appropriate graphic format.
   [Choose “Save As” from the file menu. Specify a file name, location to be saved, and the desired format in which the file should be save. Click OK.]
The following concepts are important when scanning pictures for multimedia presentations. Explain each:

A. Resolution of Scan
   The resolution of a digital picture is usually measured in dots per inch. The resolution of pictures scanned for the internet should probably not exceed 72 dots per inch, the resolution of most computer monitors. Materials scanned to be printed should be scanned at the resolution of the printer on which they will eventually be printed. Scanning pictures at 72 dots per inch helps keeps them small enough to download quickly on the internet.

B. Color Depth
   Color depth is the number of colors which will be recorded when a picture is being scanned. Black and white pictures have a color depth of two. That is they use two colors. Materials should be scanned to match the depth of the device on which they will eventually be displayed or printed. Although many computer monitors display thousands or millions of colors, scanning at a color depth in that range creates pictures that quite large. Scanning at 256 colors preserves a fairly high quality picture which will display well on most computer monitors.

C. Image Size (in pixels)
   Most scanners support pictures up to the size of a legal pad. Pictures this large, however, are too big to fit on most computer screens. The smallest monitor commonly found on computers is 640 by 480 pixels. It is usually best to scan pictures so that they will display within the screen of most monitors.

D. Other Tips
   - Reduce the color depth to the lowest possible setting:
     Thousands for very colorful photographs
     256 for cartoon like drawing and most photographs
     Black and white for line drawings and similar materials
   - Black and white pictures can be visually effective.
   - Reduce the dimensions of images to the smallest acceptable size
   - Restrict pictures to less than 640 by 480 pixels whenever possible (to fit on screen)
   - Use graphics with purpose
Digital Media
TEACHER WORKSHEET 7
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. Take pictures using the camera
2. Connect the camera to the computer.
3. Run the software for downloading the camera images to the computer.
4. Save the pictures to the hard drive.
5. Convert the pictures to gif or jpg files for use on the internet.
1. How does one create animations?

[Draw the frames of the animation with a drawing program.

The following drawings create a single handed clock with a quick rotation.

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

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

Set the frame delay for each frame as desired.

Save the file as an animated GIF file or as a MOV file.]

2. Discuss file formats which support animations.

GIF - GIF files are a universal format found on the internet and supported on all platforms. GIF files support animations which are commonly used on the internet for advertising banners and flashing pointers to draw attention to web content. GIF animations contain graphics only. They do not support sound tracks.

MOV - MOV files are a universal format found on the internet and supported on all platforms. MOV files support animations, high quality video, and sound tracks.
1. List some ways to use sounds in a multimedia presentation.
   [Present musical examples, background music, feedback for correct and incorrect responses.]

2. How does one add sound to a multimedia presentation?
   Method 1: Use the presentation program’s audio recording tool to record a new sound, if applicable.
   Method 2: Choose “Insert” or “Import” from the program’s menus and choose an existing sound file.

3. How does one create new sound files?
   Run an audio recording/editing program such as Opcode’s Audioshop, Bias’ Peak, Macromedia’s Sound Edit 16,
   or Sonic Foundry’s Sound Forge. Record a sound file using a microphone and save the file as a wav or mov
   file.

4. What are other issues to consider when recording sound?
   [See the Digital Audio Handout on the next page.]

5. How does one perform copy and paste editing with a sound program?
   [Select the desired portion of the sound file. This is usually accomplished by dragging the mouse over a portion
   of the sound and listening to see if the selection is correct. Most programs also allow the selection to be made
   by entering starting and ending times if desired. When the desired portion is selected, choose “Copy” from the
   Edit menu. Click the mouse at the point in the sound where the copied data should appear and choose “Paste”
   from the Edit menu.

6. HOW DOES ONE ADD EFFECTS SUCH AS REVERB OR ECHO TO A SOUND?
   [Select the desired portion of the sound file. Choose the option from one of the menu’s which adds the desired
   effect. Frequently the effect requires parameters (how slow an echo to add, how many recursions of the echo
   should be included, what should the relative strength of each recursion be, etc.). Effect options are usually set in
   a dialog box with sliders and field for entering values. Usually effects may be tested before they are applied or
   saved. At any rate, it is a good idea to save a copy of the sound file before applying an effect and/or undo the
   effect immediately if the effect does not work as desired.]

7. How does one save a sound in an appropriate file format.
   [Choose “Save As” from the file menu. Specify a file name, location to be saved, and the desired format in
   which the file should be save. Click OK.]
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 coming in since many of these devices send out stronger or weaker signals than the others.

B. Sample Depth (8 bit, sixteen 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 approximately 44,000 is used when music is recorded for 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 which 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 IBM computers. Choose compression which can be realized on both platforms.

F. File Types-
   WAV is the most common and is adequate for most purposes. AU is acceptable for recording speech but because the sampling rate is usually limited to 8,000, it is not a good choice for music. AIF is a very useful sound format which supports a number of sample rates, depths, and compressions.

G. Other Tips-
   - When file size is a concern
     Use MIDI files for music.
     Sample WAV, AU, or AIF files at the lowest acceptable rate.
     Keep samples short (a few seconds is best).
     Remove silence and/or noise at the beginning and end
     Use compression which works on both Mac and IBM platforms.
1. What is a MIDI file and how can it be used in a multimedia presentation?

MIDI files are the files generated by sequencing or notation software. They contain instructions for playing music on an external device such as a synthesizer or sound card. MIDI files are used to add long musical examples to presentations. They are quite compact but they do not contain digital recordings of specific sounds.

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

Choose “Insert” or “Import” from the program’s menus and select an existing MIDI file. NOTE: Some presentation software may require that a MIDI file be converted to a movie first. If so, the following procedures show how to do this using MoviePlayer on an Apple or Windows computer.

[Convert MIDI Files to movies.]

- Run Movie Player Pro or Movie Player 2.5,
- File --> Import
- Click the “Convert” button
- Click the “Options” button
- Turn on “Add Silence to the Beginning”, “Add Silence to the End”, and “Compatible with QuickTime 2.0”, and click “OK”
- Rename the file to “filename.mov”, navigate to the desired folder, and click “Save”
- Once the movie is imported, the instruments for each track may be set.
  - Movie --> Get Info
  - Choose the “Music Track” from the popup menu on the left.
  - Choose the “Instruments” option from the popup menu on the right.
  - Set the instrument for each track.
- File --> Save As
  - Select “Make Movie Self Contained”
  - Select “Compatible with non-Apple Computers”

3. How does one edit an existing MIDI file?

Open the MIDI file with a sequencing program. With the sequencing program any number of edits may be made. The tempo may be changed, ritards and accellerandos may be added, graduated and terraced dynamics may be applied, different instruments may be assigned to each voice, voices may be muted or removed from the arrangement, the piece may be transposed, and more.

4. What are the different types of MIDI files?

- Type 0 has all channels saved within a single track within the file.
- Type 1 has all channels saved in different tracks within the file.
- Type 2 has multiple songs saved within the file.
- Type 1 is recommended for most purposes.
5. When working with Standard MIDI Files, the following concepts are important. Explain each:

A. Digital Audio-
   MIDI files record the barest essentials of a musical performance - which note was played, when was it played, how loud was it played, how long was it played? Very little additional information is recorded. MIDI files do not typically include digital recordings of specific performers or performances.

B. Playback Device-
   MIDI files surrender many aspects of musical performance to the synthesizer or sound card during playback. The quality of the playback device directly affects the quality of the MIDI file.

C. Arranging Artfully for the Worst Possible Playback Device-
   It is good to consider arranging MIDI files in such a way that they sound good on a wide variety of timbres.

D. General MIDI and Patches-
   General MIDI establishes a common bank of sounds which all modern synthesizers and computers share. When creating MIDI files for the internet write for general MIDI instruments.

E. Other Tips-
   - Either use general MIDI patches or don't include them.
   - Don't quantize so much that the piece sounds "stiff".
   - Don't create MIDI files with notation programs which quantize everything.
1. Why would one use a video in a multimedia presentation.
   Video offers a vehicle by which complex processes may be explained in a nonverbal manner.
   Consider the verbal instructions for the movements to the first phrase of the “Itsy Bitsy Spider”
   Touch the end of the thumb of the left hand with the end of the forefinger of the right hand.
   Touch the end of the thumb of the right hand with the end of the forefinger of the left hand.
   The hands should have two points of contact.
   Release the lower point of contact and twist the hands so that the same fingers connect but on top.
   Release the new lower point of contact and repeat the process again and again while singing,
   “The itsy bitsy spider climbed up the water spout.”
   These instructions are complex enough that most children who would be excited about doing them
   couldn’t read or understand them. Still with a video demonstration, any school-aged child should
   be able to perform these motions.

2. How does one add existing video files to a multimedia presentation.
   Choose “Insert” or “Import” from one of the program’s menus and select the desired video.

3. How does one record a digital video?
   Recording digital video usually requires special hardware.
   Attach a camera or other video source to the computer through the video card or adapter as necessary.
   Turn on the camera or video source.
   Run the software which came with the video hardware and start recording.
   When finished, save the video in an appropriate format.

4. How does one copy and paste portions of the video.
   [This usually requires video editing software such as Apple’s MoviePlayer Pro for Windows or Macintosh
   computers. Select the desired portion of the video file. This is usually accomplished by dragging the mouse
   over a portion of the video and watching the selection to see if it is correct. An alternative method is to click at
   the starting point of the selection and hold the shift key down while clicking at the ending point of the
   selection. Some programs also allow the selection to be made by entering starting and ending times. When the
   desired portion is selected, choose “Copy” from the Edit menu. Click the mouse at the point in the video where
   the copied data should appear and choose “Paste” from the Edit menu.

5. How does one add special effects such as transitions and fades.
   [This usually requires video editing software. Select the portion of the video file to which an effect is to be
   added. Choose the desired effect option from one of the program’s menus. Frequently the effect requires
   parameters (for example, how quickly a fade-in occurs or whether it occurs in a linear fashion or more quickly
   near the end). Effect options are usually set in a dialog box with sliders and fields for entering values. Usually
   effects may be tested before they are applied or saved. Still, it is a good idea to save a copy of the video file
   before applying an effect and/or undo the effect immediately if the effect does not work as desired.]

6. How does one add additional audio or music tracks to a movie.
   [Using video editing software, open the audio track to be added. Select and copy the entire audio track. Open
   the movie to which the audio is to be added. Select an equivalent portion of the movie (same length) and use a
   special paste operation (usually from the edit menu, perhaps with a modifier key such as shift or option) to add
   the audio track to the movie.

7. How can one convert “talking head” video into a more compact structure.
   [Using video editing software, open the video. Save a copy but specify a much slower frame rate (one or two
   frames per second should be adequate for this kind of video).]

8. How does one save video in an appropriate file format.
   [Choose “Save As” from the file menu. Specify a file name, location to be saved, and the desired format in
   which the file should be save. Click OK.]
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-
   Special hardware will probably be required when recording video on the computer. A number of companies make “Picture/VideoCams” which provide an inexpensive entry-level hardware device with software. Video cards which allow input from video cameras, video cassette players, laser disk players, and similar devices may be installed in most computers for only slightly more.

B. Frame Rate-
   Motion pictures in the theater present approximately 30 frames (pictures) every second so the action on the screen will flow and seem realistic. While this frame rate is desirable, the extraordinarily large size of digital video files sometimes requires compromise. For “talking heads”, one or two frames per second (or even a still picture with an audio track) can be quite effective. For animations where realistic and flowing motion is required, it is best warn the prospective viewer, that the file will take some time to download and play.

C. File Size and Compression-
   Digital video files are extraordinarily large, even when the movie is just a few seconds long. Most programs offer a variety of compression schemes. Some of the compression results in the loss of data. Depending on how the loss of data occurs, the effect may or may not be noticeable. Experiment with different compressions but keep a copy of the original. Only compression which works on both IBM and Macintosh platforms should be used.

D. File Types-
   The most common digital video format on the internet is MOV. Two other formats are sometimes encountered: AVI and MPG.

E. Other Tips-
   - Follow all graphic and sound suggestions above.
   - MIDI soundtracks on black and white movies are small and downloadable.
   - Set the frame rate to the lowest acceptable level when files size is a consideration.
   - Consider one or two frames per second (especially for “talking heads”)
   - Save as a QuickTime movie (flat file for IBM or Mac, independent of other files)
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/copy/copyr.html](http://www.menc.org/copy/copyr.html)

Comments:

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Creating multimedia, the National Standards, & TI:ME Strategies for Music Education

1. Which national standard(s) can be addressed using multimedia materials?
   
   ________________________________________________________________
   
   ________________________________________________________________
   
   ________________________________________________________________

2. What specific ways could multimedia materials 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.

Now review the Teaching Strategies listed in the TI:ME technology strategies document. See Appendix A of the Technology Strategies for Music Education. Describe one or more ways to use internet authoring in your teaching position: [TIME INSTRUCTORS MAY PHOTOCOPY AND DISTRIBUTE APPENDIX A]

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List three ways that multimedia materials could be used in your teaching position:

1. ________________________________________________________________
2. ________________________________________________________________
3. ________________________________________________________________
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 and 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 this criteria.

### Presentation Programs

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### Web Page Authoring

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### Interactive Authoring

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Appendix 2

MULTIMEDIA BASICS: UNDERSTANDING TEXT
Steven G. Estrella, Ph.D.

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 which 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 they were typeset by a professional typographer. 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 FixedSys 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. TrueType was created in the early 1990s by Microsoft in cooperation with Apple Computer and others.

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 *Italics* 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, aka 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 defacto 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 Netscape Navigator. 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 ClarisWorks 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 environments like HyperCard for the Macintosh, Toolbook for Windows, 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 a 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 disturbances in the surrounding air. These sound waves cause our ears to send nerve impulses to the brain which interprets the disturbance as sound.
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 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 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 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 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, a file format is assigned by the recording software. Sound files are either RAM-based or Disk-based. To play back a RAM-based file, your computer must have enough random access memory (RAM) to hold the entire file. For example a computer with 8 megabytes of RAM might not be able to play a large RAM-based sound file but a computer with 16 megabytes of RAM might have no problem with it. As a result, RAM-based sound file formats are appropriate for use with short sound samples. On the Macintosh, System 7 sound and SND resource are common RAM-based file formats. System 7 sounds are used to generate the various beeps and alert sounds used on the Macintosh. SND resources are often used as sound resources in HyperCard stacks. A Macintosh sound recording program, such as MacroMedia's SoundEdit 16 or the freeware SoundHandle 1.0.3 can be used to create SND resources that can be saved directly into the resource fork of a HyperCard stack. System 7 and SND file formats are most commonly used with 22 kHz, 8-bit sound samples.

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 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 the AU file format is used by computers running the UNIX operating system. Sound editing software can convert among these and many other file formats.
Demonstration 1 - Digital Audio Sampling Rates and Resolutions

MULTIMEDIA BASICS: UNDERSTANDING SOUND - Demonstration 1
Steven G. Estrella, Ph.D.

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. Changes in sampling resolution from 16 bit to 8 bit produces more noise and degradation in quality than changes in sampling rate from 44 kHz to 22 or 11 kHz.

"Doodlin" - 44 kHz sampling rate, 16-bit sampling resolution, 644 kilobytes
http://www.ti-me.org/IWP/multimedia basics/doodle16.mov

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

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

"Doodlin" - 44 kHz sampling rate, 8-bit sampling resolution, 332 kilobytes
http://www.ti-me.org/IWP/multimedia basics/doodle844.mov

"Doodlin" - 22 kHz sampling rate, 8-bit sampling resolution, 195 kilobytes
http://www.ti-me.org/IWP/multimedia basics/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 PC. 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.ti-me.org/IWP/multimediabasics/convertmidi.mov) demonstrates the process of converting a standard MIDI file into a QuickTime movie using the MoviePlayer Pro application available from Apple Computer's web site (www.apple.com or quicktime.apple.com).
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.ti-me.org/IWP/bluesjam/bluesjam.html) is an example of this application.
Apple Computer's 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, available from Apple's web site at http://www.apple.com, comes with MoviePlayer to play back QuickTime content. Content creators must purchase the "Pro" version of QuickTime for $30. The "Pro" version comes with MoviePlayer Pro which can convert standard MIDI files into QuickTime movies that can be played back by any Macintosh computer (Mac II or later) or any PC with a sound card and Windows 3.1 or later. 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.

MoviePlayer can be used to convert audio from compact discs into QuickTime movies that can be used in multimedia presentations. MoviePlayer can be used to add sound and text tracks to digital video. Using a video recorder, Apple's free Video Player software, and a Mac equipped with video input, you could record a movie demonstrating instrumental techniques and then use MoviePlayer 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, try the QualComm PureVoice Compressor is a good choice. For video, the Sorenson 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 next version of QuickTime, version 4.0 currently in Beta testing, 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 MacroMedia SoundEdit 16. Using free and shareware software available from Apple and others, however, you can create multimedia presentations to inspire and educate your students.
Apple Computer's 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. One some models, however, the PlainTalk microphone is a $30 option. For some PCs running Windows, however, you may need to buy a sound card and have it properly installed by a technician.

A great place to find shareware and freeware audio software for your computer is [http://www.shareware.com](http://www.shareware.com). QuickTime software and links to other multimedia software can be found at Apple Computer's QuickTime web site, [http://www.quicktime.apple.com](http://www.quicktime.apple.com).
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>
<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>
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<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>
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<tr>
<td>5</td>
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<td>Simple Color Icons</td>
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<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 640 wide by 480 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 800 by 600 pixels or 832 by 624 pixels. Larger monitors (17-inch or 20-inch) typically can use these resolutions as well as 1024 by 768. 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 600 pixels wide and 400 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 that are intended to be printed on high-resolution imagesetters or laser printers because they store detailed instructions in the PostScript page description language for recreating the image file. A PostScript-equipped imagesetter or laser printer can then recreate the image at resolutions of 300, 600, 2400, or more dots per inch (dpi). Color PostScript imagesetters 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 MacOS 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 small file sizes 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, can not 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

Figure 2 - the same two objects, resized and relayered.

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 objects 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.
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 CDROM 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. 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 can not 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 ("broadcast quality") 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 30 per second. The amount of disk space needed to store broadcast quality video is truly enormous. A grid of 640 by 480 pixels contains 307,200 pixels. If each pixel uses 24-bits to represent color then a single frame uses 7,372,800 bits or 921,600 bytes (one byte = eight bits). 30 frames would then use 27,648,000 bytes or nearly 28 megabytes. At this rate, one minute of broadcast quality video would consume 1,658,880,000 bytes or 1.65888 gigabytes of hard disk storage. Most computers today ship with between 1 and 2 gigabytes of storage making their hard drives inadequately small for storing broadcast quality video.

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 20 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. For example, a typical "talking head" video features a person on a stable background. Compression/decompression schemes (codecs) might use a technique called "frame differencing" to store only those elements of each frame which are different from the previous frame. Compression can greatly reduce storage.
requirements often with little loss of picture quality. Using a video recorder, Apple’s free Video Player software, and a Mac equipped with video input, you could record a movie demonstrating instrumental techniques and then use MoviePlayer 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, try the QualComm PureVoice Compressor is a good choice. For video, the Sorenson 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 next version of QuickTime, version 4.0 currently in Beta testing, 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.

For more detailed and advanced editing of video and audio, of course, you might purchase professional software like Adobe Premiere and MacroMedia SoundEdit 16. Using free and shareware software available from Apple and others, however, you can create multimedia presentations to inspire and educate your students.

Figure 1 - QuickTime
Apple Computer’s QuickTime software can be used to create movies with any combination of video, audio, MIDI data, text, and animations.
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/multimediabasics/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/multimediabasics/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/multimediabasics/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/multimediabasics/swab.gif