Lesson Plans

Teacher's Supplement

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Making Music, Making Meaning

Based on The Craft of Songwriting project contributed by Kim Alessi, music and technology teacher, head enrichment teacher, The Perkins School, Seattle, WA

Kids today are into their music; they shuffle down the street, headphones on, iPods pumping out MP3s, silent to everyone but them. For a few minutes, they become Christina, Britney, Eminem, or the latest teen idol, belting out vocals or strumming on their air guitar. They listen to all kinds of music—hip hop, rap, rock, metal, blues, and pop—at home and on the go.

This project taps into students' passion for music and enables them to discover the craft of songwriting so they can begin to make their own music and tell their stories through song.

Project Summary

- Students write lyrics on a subject and then compose music in GarageBand to express the theme (and their lyrics).
- Primary and elementary school students may best work in groups, whereas middle school and high school students could work in groups or independently.
- Multiple tracks of instruments can be added to produce a rich composition. A vocal track of the student performing the lyrics is recorded and mixed in.

Grade Level/Subject

K-12/language arts, music

Lesson Goals*

- Students learn how to research, plan, and create an original piece of music.
- Students learn to interpret known or new information using music and lyrics.
- Students learn how to create a music CD.
- Students learn about copyright issues (optional).

*Consult your state's benchmarks for social studies, language arts, and speech for specific goals.

Learning Objectives

Academic

After completing this project, students will be able to:

- Consider the curriculum studied (current events, history, and so on) and interpret this information into song lyrics.
- Consider how songs can be used for both educational and entertainment purposes.
- Use appropriate tempo, tone, and instruments to create the desired emotional effect in a musical composition.

Technical

After completing this project, students will be able to:

- Use AppleWorks to write the lyrics for their songs.
- Use GarageBand to record or arrange a variety of musical tracks, including rhythm, instrument, and vocal tracks.
- Burn a CD of their finished compositions.
- Create artwork for their CD covers.

What You'll Need

- Macintosh computer (with CD burner)

- iLife tools (GarageBand, iTunes, iPhoto)

- AppleWorks

- Microphone (A microphone that produces a loud line-level signal is recommended, or you can purchase a USB interface, such as the M-AudioMobile Pre, which can accommodate a regular microphone or musical instrument.)

- USB keyboard for entering melodies into GarageBand (recommended)

- Printer (for CD covers)

- Internet access

Deciding on the Final Product

- Create a CD. The project finishes with a student-produced CD, complete with cover and jewel case to share with friends and family—or students can send it to their favorite record label and *Billboard* magazine!

- In addition to their personal CDs, students can make a compilation CD of all student works on one or two discs.

- Create a Web page. Students can create a Web page and post their songs as MP3 files along with the lyrics to their songs.

- Create a music video. Students import their music into iMovie and illustrate it with images, photos, or digital video to create a music video based on their original song.

Outcome-Based Assessment

- Work together with students to create an assessment rubric that includes how they will evaluate:

  - Lyrics

  - Music

  - Subject content

- Students can provide peer-to-peer feedback.

- Copies of the CD can be added to the students' electronic portfolios.

I. Getting Started

Teacher Planning

- You may want to find and contact musicians, especially songwriters, in the community and invite them to give a brief presentation to the class about their work and how they transform their ideas into a song. Have them talk about the process and how they evaluate their own lyrics, instrumentation, rhythm, and melodies. Invite them to bring a sample of their music to play to the class.

- Try writing your own lyrics and composing your own music in GarageBand as a way of learning the software.

Preparing Students

1. Use a collaborative classroom project to prepare students for their individual projects.

2. As a group, students will explore the songwriting process, from creation of lyrics, to the creation of vocal and music tracks, to the final mixing and export of the song.

3. Craft lyrics in groups with the help of a kick-off phrase such as "I woke up in the morning…" or "Today's the day…" Consider drawing on themes from classroom studies, such as the American Revolution or the Civil Rights movement: "Freedom to me…" (history) or

"This amazing machine…" (physics). Alternatively, create lyrics about the news. Bring in today's newspaper and spread out pages on everyone's desks. Have each student submit a phrase, image, or idea inspired by a story on his or her page and write it on the blackboard.

4. Have students combine these phrases, consider the ideas, and create lyrics. Then give a mini-lesson on rhythm and rhyme (start with iambic pentameter and the ABAB rhyme scheme). This may help students form structured verses and choruses.

5. After students create lyrics as a group, open GarageBand. You may want to play the iLife in the Classroom DVD and follow along with Jim Heid as he explains how to use this great music-creation software.

6. Listen to a variety of loops (see page 236) and discuss what kind of beat, instruments, and tempo seems appropriate to the lyrics or purpose of the song. Try different loops and then pick one to begin. You may want to start with a drum beat and then add a few layers. (Add a vocal track by singing into the computer through the internal microphone or through an external microphone. Listen to the tracks on a headset and sing the lyrics into the microphone. The vocals will appear as another track. When the song is complete, remove the headset, turn up the volume, and play the song for the class.)

A song is born. Of course you could finesse the instruments, singing, and mixing for days, as real musicians do, but remember that this group project is a warm-up for songwriting.

II. Setting the Stage

Introducing the Project

- Ask students to bring to class a piece of music or a song that they like. Play short samples of each song and invite discussion about what the students they like. (Give a clear message about songs with offensive lyrics staying at home.)

- Invite students to comment or record observations about their pieces of music, considering rhythm, lyrics, and any thing else they'd like. What else do they need to know to discuss the songs?

- Lead a brief introduction to songwriting by playing a variety of pieces by different artists, studying the components of each. Invite discussion of how each piece compares with the others. Write down new categories on the board as comparisons emerge. Categories could include:

  - Lyrics: Who or what is the subject of the song? What is it trying to say?
  - What type of language is used (metaphors or other uses of imagery)?
  - Melody: How does the melody create a mood or feeling?
  - Rhythm: How does the rhythm contribute to the mood or feeling?
  - Tempo: Use a metronome to measure the pulse.
  - Genre or type: blues, rock, country, gospel, hip-hop, and so on.
  - Instrumentation. Make a list of instruments while you listen.

- Create lyrics, brainstorming first lines with the entire class or in groups. Consider possibilities to highlight your latest unit. For example, include personal stories and observations as part of a unit on personal narrative in language arts, or a historic event or a famous person for history. Lyrics might also focus on a news item from current events, a book review, a science or math concept, a foreign language project, or almost any subject area.

III. Organizing the Project

Production Binder

- Students should keep a folder with all drafts of their lyrics, from first draft to final. Include initials of class-mates or teachers for each revision.

- Include class notes on instrumentation and ideas on tempo, melody, rhythm, and vocal styles. Students should also write short pieces exploring these ideas and how they might apply to their songs.

- Students create and print a final draft of their lyrics in preparation for the recording session.

IV. Completing the Tasks

Music Production

- Students open a new file in GarageBand and listen to the different prerecorded loops.

- They build their composition by adding more loops and more layers.

- Students sing their song while hearing the music tracks through their headphones.

- Students can use different approaches to create their songs:

  - One method is to lay down a rhythm track first (from one of the loops) and then, listening to the loop on a headset, sing into the microphone; the loop keeps the student in tempo, just like in a recording studio. Then students can add the layers of instruments and redo their vocal recordings as often as they require.

  - Another method is to sing the song first within any other track and use this as a guide to selecting an appropriate track and appropriate instruments.

  - There is no single right way for all learners, so encourage experimentation and the sharing of tips and tricks.

V. Putting It All Together

Output

- Students edit the song and then export it to iTunes.

- In iTunes, students burn the file onto a CD.

- Artwork for the jewel case (the plastic case that protects the CD) can be created by importing and editing images in iPhoto or AppleWorks and then printing them in a size to fit the case. Information could include the name of the song, the artist, the year it was produced, the lyrics, or any other information the student may want to include.

- A class CD can be created. Each of the finished songs can be imported into iTunes and then all of the songs burned onto one class CD. Printed information can provide the track names, artists, and song titles and perhaps a group photo on the cover.

VI. Sharing the Project

Presentation

Students present their CDs to the rest of the class and talk about the choices they made in constructing their lyrics and music.

Additional Activities

- Create a class Web site and load the songs on it, along with song lyrics and other projects or writings.

- Arrange a presentation of all songs for friends and family.

- Students may want to illustrate their songs with images and video in iMovie.

- Use this project as a springboard for discussing copyright. Discuss how it feels to create an original piece of music and how much effort and thought it requires, and then discuss how students feel about music sharing and the use of other peoples' music without permission.

VII. Wrapping It Up

- Get students together in groups to discuss how it felt to write and produce a song:
    - What did the students learn about music?
    - What did the students learn about the subject they were exploring?
    - What excited the students about the project?
    - What will each student's next song be about?
- The teacher and the students assess the students' songwriting projects based on the rubrics they created earlier.

VIII. Variations

Customizing the Lesson for Other Age Groups

Songwriting projects can be introduced to students of all ages. Depending on students' familiarity and comfort with music, instruments, and GarageBand, they can use this project to explore their understanding of other subject areas.

- Primary school students, with a teacher's assistance, might record a group song in GarageBand and then, trying a variety of loops, hear how the same lyrics sound when played with different kinds of instruments and rhythms. The song could be a collaborative piece, with each student writing a two-line phrase, sung to a familiar tune ("Row, Row, Row Your Boat," for example). Each student might then sing his or her own part, or the entire class could sing the whole piece.

- Elementary school students, working in small groups, might create a song about an historical event or person. Each student could contribute a verse to the group's song, and then the whole group can decide on the chorus. During recording, each student can sings his or her verse, and the whole group can join on the chorus.

- Middle school students might take on the persona of a person in history or current events that they are studying and create a song from that person's point of view, or explore a spectator's point of view. Make the song dramatic or humorous ("It looked extremely dismal for the Greeks that held the pass / The Persians quite outnumbered them / They surely wouldn't last"—from a spectator watching Leonida of Sparta and the battle of Thermopylae). The songs are then recorded with instrumentation and rhythm and presented to the rest of the class.

- High school students can create a song that explores a news event from another country. The challenge is to research and use appropriate instruments and rhythms of that country in the GarageBand composition.

Living History: Interpreting History Through Role-Playing

Based on the An Immigrant's Journey project contributed by Laura Best, technology teacher, and Joanne Roler and Ruth Tinley, social studies teachers, Daniel Wright Junior High School, Lincolnshire, Illinois; and on the A New Home, A New Life project contributed by Paul Tomizawa, elementary computer teacher, Scarsdale Public Schools, Scarsdale, New York.

Students' exploration of history comes alive when they take on the roles and lives of the people of that era. Whether they are dressing in togas and exploring life in everyday Greece or Rome or exploring the events of the recent past, such as the Civil Rights movement, students gain a deeper understanding through the creativity that role-playing affords.

In a report titled "The Impact of Media and Technology in Schools" (1998), Thomas C. Reeves, PhD, of the University of Georgia describes the results of an interesting experiment in learning by R. Lehrer. He explains how two groups of eighth graders studied the American Civil War, one via traditional classroom practices, and the other through a multimedia, role-playing process. At the end of the year, both groups took an identical test, and "No significant test differences" were found. A year later, however, the two groups were retested on the same material. The traditional-learning group "could recall almost nothing about the historical content, whereas students in the design group displayed elaborate concepts and ideas that they had extended to other areas of history." The full document can be found at www.thedirectorintheclassroom.com, under Resources/Articles, Papers and Reports.

This project uses narration combined with digital photographs and digital video to tell the stories of immigrants who came to America between the mid-nineteenth and mid-twentieth centuries.

Project Summary

Students learn about the lives of immigrants coming to the United States by engaging in an authentic learning experience involving research, journal writing, digital photography, and movie production using iMovie. By acting out the immigrant experience, students gain a deeper understanding and appreciation of the journey of immigrants to a new land. The use of auditory, visual, and musical components helps include and engage more students.

The iMovie can consist entirely of narration over still images that students have created of themselves in the costumes and sets of the period, or it can incorporate live-action video or any combination of imported archival still and motion pictures, sound effects, music, graphics, maps, models, and titles.

Grade Level/Subject

Elementary/language arts, history, drama

Lesson Goals*

- Students learn about an important historical event by adopting an immigrant persona and giving a first-person account of their adventures.

- Students learn to conduct research on topics of historical importance.

- Students participate in a dramatic presentation to illustrate their understanding of history.

*Consult your state's benchmarks for social studies, language arts, and speech for specific goals.

Learning Objectives

Academic

After completing this project, students will be able to:

- Tell the stories of immigrants in America in the mid-nineteenth to mid-twentieth centuries.
- Write a script that balances the emotion of the images with factual content.
- Understand the power of visual imagery to convey emotion.
- Select music that supports the mood of a story.
- Experience the use of technology to create a personalized document of an historical experience.
- Better understand the immigration experience of their family and friends.
- Better understand historical events.
- Use technology to express and reinforce the learning process.
- Use communication, research, and creative skills to produce a movie.

Technical

After completing this project, students will be able to:

- Use the Internet to search for appropriate and reliable information and images.
- Record narration using iMovie.
- Operate a digital video camera.
- Download, organize, and edit photos using iPhoto.
- Use iTunes to import music tracks.
- Import and edit picture and sound files to create an iMovie project.
- Use a scanner to capture images (optional).

What You'll Need

- Macintosh computer (SuperDrive recommended to create DVDs)
- iLife tools (iMovie, iTunes, iPhoto, iDVD)
- AppleWorks (for screenwriting)
- Digital video camera
- Tripod (recommended)
- External microphone (recommended)
- Scanner (optional)
- Internet access
- Student production binders
- Costumes, props, sets (optional but fun)

Deciding on the Final Product

- Create a movie. Students can create a movie using narration over a series of still digital photographs as in the A New Home, A New Life project, or over a series of videotaped images, graphics, and stills as in An Immigrant's Journey. Both can be viewed on the Apple site at www.apple.com/education/ilife, under Social Studies projects. Students can export the finished iMovie to VHS or DV tape or burn it to a CD or DVD. They can also finish it as a QuickTime movie and present it on a Web page.

- Create a photo book. As an additional activity, use digital still images (from a digital camera or from exported iMovie frames) to create a photo book in iPhoto. The narration of the immigrant's journey can provide the text to accompany the photos. The book might take the form of a diary, with dates and locations, or each page of text might be a letter written and sent to loved ones back home.

Outcome-Based Assessment

Student Role

Students will plan their goals and objectives for the project, including:

- How they will research the immigrant experience.
- How they will tell their immigrant stories.
- How they will demonstrate their understanding of the immigrant experience.

With the teacher's guidance, students will create their own rubrics to assess their work on these goals and objectives.

Teacher Role

- The teacher and students together should develop a rubric to demonstrate methods for conveying emotional and research-based content in the video stories.
- The teacher might develop and give students a checklist of research criteria and technical needs for digital photography and iMovie work (see the iPhoto and iMovie sections of *The Macintosh iLife in the Classroom*).
- Design and explain to students how you will assess the supporting material in the production binder, which includes:
  - Written journal entries
  - Scripts/narration
  - Storyboards
  - Planning documents (for example, lists of costumes, props, and sets needed)
- Develop a rubric for assessing:
  - Camera and audio recording (image and sound quality)
  - Video importing and editing skills
  - Scanning and importing of additional material
  - Creativity
  - Overall impact
- Determine other curricular outcomes that could be incorporated into this project from other subject areas, such as social studies, geography, and art.

I. Getting Started

Teacher Planning

- Teachers should become familiar with immigration resources on the Internet and with the use of a video camera and iMovie. You may want to create your own immigrant project to develop technical expertise and also to demonstrate the project to students.
- The teacher's own connection to the project is important. Make a list of the people in your own life who have immigrated to this country or moved to another country. What kinds of experiences have they (or you) had and what stories do you recall? Were the streets really "paved with gold," or was there hard work, struggle, and disappointment on the roads of the new world? Why did people arrive one hundred years ago, and why do they continue to arrive? How have things changed?
- Which of your experiences could you talk about to your class as an example of your own personal connection to immigration?
- Be familiar with these Internet resources:
  - The Immigrant Experience (http://ellisisland.org/immexp/indexFrame.asp?)
  - Ellis Island History (www.ellisisland.com/indexHistory.html)

Preparing Students

- Present students with the stories of immigrants, using poems, song lyrics, books, and video and audio clips.

- Invite people you know who have immigrated, either recently or in the more distant past, to speak to the class about their experiences. Or ask local multicultural organizations if they have members who would enjoy sharing their stories with your students.

- Students themselves may have recently immigrated, or they may know people in their own families who have. Consider how you can help them connect their experiences to the broader, historical experiences of immigrants of the past. How do the experiences compare?

- Introduce students to iMovie and teach them how to import and edit their photos and add narration and music.

II. Setting the Stage

Introducing the Project

- For students to make a lasting personal connection to history, it is essential that they have an opportunity to investigate history through their own experiences and those of their family members and friends. Begin with a discussion of what history is, how it happens, and how we are all part of it. Ask questions to explore why learning history is important.

- Brainstorm to explore how history is preserved (include oral history: the stories handed down from one generation to the next).

Connecting Known Information to New Learning

- How familiar are students with the concept of immigration? Work on a class definition.

- A teacher-led discussion could explore how immigration differs in today's world. Why do people leave their countries today to come to a new land? How do they travel and how long do their journeys take? Do they land at Ellis Island? How do they begin a new life in a new land?

- Put up a map of the world and solicit stories from the class about the immigration experiences of their own families or of people they know. Use push pins and thread to mark and connect where people came from and where they landed.

- Have students record in their journals and answer as best they can questions such as:

  - How long do you think it took to come by boat from Italy in 1900? From China?

  - Where did most people come from at the turn of the twentieth century?

  - What were some of the reasons people left their families and countries to come to a new land?

III. Organizing the Project

- Decide whether to have students work individually, in pairs, or in small groups and then create those groupings.

- Hand out or have students create production binders.

- Students conduct research using the Internet, children's literature, and reference texts to learn why people left their homeland for America and the hardships they endured.

- Students adopt an immigrant persona and keep a journal on that person that reflects their research. The journals provide the storylines for the students' iMovie projects.

- If a group is working on one person, each student could research a different part of the immigrant's journey. For example, a group of four students could look at these aspects:

  - The decision to immigrate

  - The voyage

  - Ellis Island or other entry point

  - The search for housing and a job in a new land

- Each student writes one journal entry for the fictional person. Students read and assess each other's entries, and then, as a group, they edit and modify the journal entries until they sound as authentic as possible.

- Each group uses the journal entries to write the narration for the iMovie project. One person in each group is selected to be the fictional person to narrate the immigrant's journey.

- The group reviews the images they have gathered to determine the ones that are most appropriate for their presentation. Or for a variation, use only one person and have each group of students be responsible for one part of the immigrant's journey (the decision to immigrate, the voyage, Ellis island or other entry point, the search for housing and a job). Then combine all the parts to create one or two class movies.

- Students research costumes, props, and sets of the period and then construct or find these before they begin filming.

Production Binder

Students create a production binder to keep track of their project information. The binder is assessed along with the project.

The binder might include a project criteria sheet, journal pages, immigration research notes, storyboard ideas, a script or diary, and scheduling and contact information regarding filming, if applicable. It might also contain lists of additional photos, videos, graphics, music, and audio ideas to support the project, as well as any other project notes.

Journal

Students keep a journal of their immigration project from beginning to end and use it to document their ideas, thoughts, and revelations about the project.

Script/Diary

Students can record the diary entries of their assumed persona in a diary section, which can progress from notes to rough draft to finished copy for narration.

Storyboard

Students can storyboard their ideas for presenting their immigrant's journey. They should use storyboard sheets to visually indicate how their project will work. For example, they might storyboard an introduction that consists of archival photos or maps or that consists of reenacted video or stills.

Students should also list ideas for titles, graphics, maps, narration, and effects so they can visualize their finished film. For example, students may want to film a tiny toy boat going across a map to show the journey from Italy to America, so they can indicate where this will fit in and how they plan to film it. Or students may want to use the Sepia Tone filter to make their film look like archival footage, so they can indicate which sections this effect will be applied to. Or students may have ideas for a title sequence that features a montage of still photos from the era; this, too, can be indicated in the storyboard.

IV. Completing the Tasks

Still Photograph Version

Students use a digital camera to take photos of groups of four to six students dressed in costumes from the era covered by the project. Students pose as immigrants in scenes that reflect the hardship of leaving one's country and coming to the United States.

Digital Video Version

Students use a digital video camera to reenact scenes from an immigrant's journey. They may choose to shoot a short scene that incorporates dialogue so that not all the information and story is revealed by the narrator.

Tips for recording the drama:

- Make sure you have adequate shot "coverage."

  1. Film the entire scene in a wide shot to establish location and characters.

  2. Film the entire scene again, but this time move the camera closer to the main actor so that you have a close shot of the person from start to finish. Repeat this with each main character.

  3. Record some cutaway shots. These could be shots of other actors in the background or close-ups of something on the set or something that the main actor is holding, touching, or doing.

  Having all of these shots gives you maximum flexibility when it comes time to edit, because you will have a wide variety of shots to choose from. You determine where your audience's attention is directed by the shots you use.

- Use a tripod to get a steady shot, or experiment with holding the camera, which offers freedom to move around the action. Or use a wheelchair while holding the camera, to give the feeling of movement without the bumpiness of walking.

- Make sure the footage is in focus. The best way to do this is to zoom in as close as possible, then focus, and then zoom back out to the desired shot.

- When recording the audio portion of the video, use an external microphone.

V. Putting It All Together

Editing Visuals

- Import the photos into a class album in iPhoto. Once the photos are in iPhoto, they can be changed to a sepia tone. The whole class can then share the photos.

- Use the Internet and other research media to compile immigration-related photos and facts to include in movies. Import these into iPhoto as well.

- Royalty-free, education-friendly archival video, historical photos, and historical sound clips can be found at www.thedirectorintheclassroom.com, under Free Stuff.

Editing Audio

- Students can include music to help convey the mood of their movie project, importing music from the era into iTunes. Or students can create an appropriate soundtrack in GarageBand.

- Students record narration based on their journal entries. The photos and music provide the emotional content, so the narration should primarily offer viewers research-based information.

- Students add credits and other elements to complete their iMovie projects.

- If time allows, students can present a rough-cut screening of their films to a small audience of peers and then make any modifications necessary as a result of the feedback.

- The movie should include a segment of correctly cited research information.

- Projects can be exported from iMovie to QuickTime and then burned onto a CD or exported to videotape (DV or VHS).

- The movies can be saved in iDVD and burned on one class DVD or exported to QuickTime and burned on a CD and shared with guests at a presentation and celebration.

VI. Sharing the Project

Presentation

Students will present their finished films to the rest of the class and discuss what they learned about the immigration experience. At the same time, they might also share other stories or experiences that they uncovered in their research.

A presentation can be arranged to show all the films to parents and family either at the school or at a local theater or cinema. You may need to arrange for a video or data projector and a sound system for this; check with your school or a local audiovisual rental company.

VII. Wrapping It Up

- Invite student discussion and comments related to this project:

  - What did students learn about the immigrant experience?

  - What would students do differently with their stories?

  - How would students change their production plans (angles, audio, lighting, and so on)?

  - How would students change their postproduction plans (editing, music, sounds, and so on)?

  - Were students engaged by the project? What about the project engaged them? Why?

- Students fill out their rubrics, justifying their achievement:

  - How well did you plan your goals?

  - How will you show that your objectives were met?

  - How well did you demonstrate that learning took place?

VIII. Variations

Customizing the Lesson for Other Age Groups

In middle school, role-playing can be used to explore history, literature, science, and other subjects and can address multiple learning outcomes.

Although high school students are less inclined to dress up and perform skits, the idea of this project and of adopting a persona can certainly be adapted to this age group. High school students in history, for example, can create characters from the era being studied and narrate a diary (of a journey, a battle, an adventure) and illustrate it with images (moving and still).

Related iLife Projects

Many other related iLife projects can be found at www.apple/education/ilife.

Some of these include:

- The Legend of the Yellow Rose

- I served in the American Civil War

- Living Yesterdays History Today

The Need to Measure Speed

Based on the project Measuring Speed with iMovie, contributed by Steve Pandolfo, e-mail Internet specialist, Grapevine–Colleyville Independent School District, Grapevine, Texas

All of us are awed by the speed of Olympic downhill skiers, NASCAR racers, baseball pitches, and tornadoes. But just how fast do these people and objects move? How fast is fast, and how do we really measure speed?

Taking accurate measurements and recording data exactly are important science skills. It's also necessary to know how to use math formulas to convert different units of measurement. This lesson provides real-world applications of a variety of math and science skills. Using a digital camcorder, iMovie, and a spreadsheet program, students measure the speed of a variety of objects.

Project Summary

In this project, students record each other running, walking, throwing a ball, or doing a similar activity for a set distance. They then import their video clips into iMovie. Using the seconds and frames per second it takes to record each activity in the video, they convert their figures to miles per hour. They then record their data in AppleWorks and discuss questions that relate to their observations and measurements.

Grade Level/Subject

Middle school/math and science

Lesson Goals*

- Students learn how to calculate the speed of an object using video.
- Students learn about the relationship of speed to different objects.
- Students learn to collect and analyze data to solve problems.

*Consult your state's benchmarks for social studies or language arts for specific goals.

Learning Objectives

Academic

After completing this project, students will be able to:

- Measure the speed of an object using video.
- Convert feet per second to miles per hour.
- Convert seconds and frames to a decimal value.
- Convert a fraction to a decimal.
- Understand the importance of consistent and accurate measurements.
- Understand a real-world application of math and science skills.
- Express and reinforce the learning processes through technology.

Technical

After completing this project, students will be able to:

- Use an AppleWorks spreadsheet to enter, organize, and calculate data.
- Use a digital video camera to record an experiment.
- Use iMovie to import video and measure clip time.

What You'll Need

- Macintosh computer (SuperDrive recommended to create DVDs)
- iMovie
- AppleWorks (spreadsheet)
- Digital video camera
- Tripod (recommended)
- Tape measure
- Traffic cones or other highly visible markers
- Objects or means of transport

Outcome-Based Assessment

At the end of the project, have the class discuss some or all of the following questions, depending on grade level and ability:

- For thrown objects, how does the amount of arc correlate to speed?
- For walking or running, how would you calculate the length of an individual's stride?
- How much difference does it make in the final measurement of miles per hour if the decimal time is rounded to two decimal places?
- How would you determine the accuracy of these measurements?
- What factors could affect the accuracy of the measurements?
- How would you calculate and measure a "margin of error"?
- Outside of the classroom, what other industries or government agencies could benefit from the use of video to measure speed?
- What are the mean, median, and range of a given set of speeds?

Determine individual understanding by having students fill out an exercise sheet with the same concepts. Here is an example: If Bicycle 1 takes 2 seconds and 15 frames to travel from pylon to pylon, a distance of 100 feet, and Bicycle 2 takes 80 frames, which bicycle is traveling faster? Why? What is the rate of speed for each bicycle? What is the average rate of speed?

I. Getting Started

Teacher Planning

Using the Internet, research the speed of a variety of objects, both natural and man-made. (Hint: In your search engine, enter the name of the object and then fastest and mph and see what you find.) Here are some starting points:

Meteor	40,000 mph (approx.)
Fastest land vehicle	763 mph
Baseball pitch	100 mph (Nolan Ryan, August 20, 1974)
Cheetah	70 mph
American cockroach	3.4 mph

Preparing Students

How fast is fast? Invite students to estimate how fast a really fast baseball pitch is. (Answer: 100 mph.) How fast does the space shuttle travel above the earth's atmosphere? (Answer: 17,580 mph.) How fast is a gazelle or a panther? (Answer: 72 mph for short distances.) Ask students to estimate the speeds of other items in your list, the longer and more diverse the list, the better.

Discuss how we measure speed and why we might need to know and compare the speed of different objects. Introduce the unit and explain that the project will help students understand these concepts, using speed in their own lives. Explain that they will be estimating the speeds of different objects that will be used in the experiment (rollerblades, skateboard, bike, and so on) and recording that information to compare it with actual results.

The day before filming, students should create an AppleWorks spreadsheet to record the objects that will be tested. They will then enter their own estimates after the project is completed. Be sure that you have students who can handle the camera and tripod, and rehearse setting up the camera to get the best measurements.

II. Setting the Stage

Introducing the Project

- Have students view a short iMovie clip and demonstrate how the program measures time in seconds and frames. Using the program, ask the students to determine the number of frames in one second. Explain to students how speed can be measured by counting the number of seconds and frames an object takes to travel a given distance.

- Students should estimate which of the objects that will be tested will have the greatest and the least speed.

III. Organizing the Project

- Ask students for suggestions of things or activities to measure for speed, such as running, walking, ball throwing, bicycling, skateboarding, rollerblading, and so on. Determine with the class which items or activities will be measured.

- The class should also agree on consistent measuring points for people or items, such as the front edge of the wheel, leading foot, center of the ball, or midline of the body. Emphasize the importance of the accuracy of these measuring points. Demonstrate how to correctly line up the measuring points to the markers. This will help ensure consistent and accurate measurements.

- Plan a location and day to do the measuring. Allow an entire class period to prepare and record data.

IV. Completing the Tasks

Video Production

1. In a parking lot or other large area, divide the class into groups of five or six.

2. Using a tape measure, have each group measure a specific distance, such as 25 feet.

3. Mark the beginning and end points of the distance with traffic cones or some other highly visible marker. Place additional markers about 10 to 15 feet on both ends of the measuring zone to provide acceleration and slow-down areas. Note: Two measuring zones of different lengths could be marked off, and the speed measurements from each could be compared.

4. Have groups set up their digital camcorders at a right angle to the length of the measuring zone and frame the shot to include an area slightly wider than the measuring zone. If possible, use tripods to get steady shots, and set the camera height so the line of sight is close to the height of the markers.

5. Have groups shoot video of individual group members doing the activity for the given distance. Stop the recording between students to create individual clips for measurement. Using visual observation, students should predict which items or students are fastest and slowest.

V. Putting It All Together

Editing

1. Have students import the video into iMovie. They should rename each clip so it can be identified later. They should crop excess footage from the ends of each clip and move all cropped clips to the timeline to temporarily store them.

2. Ask students to move the clip to be measured to the shelf. This sets the timecode at the beginning of the clip to 00:00.

3. Using the arrow keys on the computer keyboard, have students move the playhead forward until the designated measuring point of the person or object is even with the starting marker in the measuring zone. Students should note the timecode at this point. They should continue moving the playhead forward until the measuring point of the person or object is even with the ending marker in the measuring zone. They should note this timecode as well.

4. Have students measure the time it takes the person or object to travel between the starting and ending markers by calculating the difference between the starting and ending timecodes recorded in the previous step. For example, if the starting timecode is 00:05 and the ending timecode is 00:25, it took 00:20 (20 frames) to travel the distance in the measuring zone. Ask students to enter this data in an AppleWorks spreadsheet. They should then move the clip back to the timeline.

5. Have students select another clip and repeat the preceding steps until all clips are calculated.

6. Students should convert the times recorded in the previous step to decimal form by dividing the number of frames by 30 (NTSC) or 25 (PAL). They should enter this data in the spreadsheet. For example, 1 second and 15 frames (NTSC) converts to 1.5 seconds in decimal form. (Students could calculate to six or seven decimal places.) Note: Fractions can be used for the conversion to decimal format. For example, 15 frames is 15/30 of a second. Reducing the fraction yields 1/2 a second, or 0.5 second.

7. Students should calculate the speed of the person or object by dividing the distance traveled (the measuring zone) by the decimal value from step 6. This determines the speed in feet per second. Students should enter this data into the spreadsheet. For example, if it took 0.6 second to travel 25 feet, dividing 25 by 0.6 would yield a speed of 41.67 feet per second.

8. Ask students to convert the feet per second to miles per hour by multiplying the figure arrived at in step 7 by 0.681804. They should enter this data in the spreadsheet, without rounding. Note: The Mac OS X Calculator's Convert function can be used to convert feet per second to miles per hour.

9. Have students create an additional column in the spreadsheet program for miles per hour, rounded to one or two decimal places.

10. Have students compare their predictions to the data recorded in the spreadsheet.

VI. Sharing the Project

Presentation

Students present their findings as a group and discuss what they have learned about measuring speed.

VII. Wrapping It Up

- Using the questions in the assessment section, evaluate students' understanding in a group discussion. Have students estimate again the speeds of the objects mentioned at the beginning of the unit to determine understanding and appreciation for the speed of relative objects.

- Determine individual understanding by having students fill out an exercise sheet with the same concepts. Here is an example: If Bicycle 1 takes 2 seconds and 15 frames to travel from pylon to pylon, which is a distance of 100 feet, and Bicycle 2 takes 80 frames, which bicycle is traveling faster? Why? What is the rate of speed for each bicycle? What is the average rate of speed?

VIII. Variations

Customizing the Lesson for Other Age Groups

- Instead of going outside, students might race small toy cars along the classroom floor. Put one line of masking tape on the floor and another 10 feet away. Set up the tripod on a table and have it looking down on a wide shot, so it sees both tape lines, or try filming from the side if you have enough room. Students can analyze the video to determine the speed of their cars.

- For elementary school: Many elementary mathematics learning outcomes target estimation, probability, measurement, computation, patterns, reasoning, and real-world applications. All of these can be integrated into this project. Students can film the objects and, with the teacher's assistance determine the speed.

- For high school: A good example of a high school project that uses iMovie to measure the speed of a projectile is the iMovie Projectile Project at Apple.com/education/ilife. It incorporates many of the elements of this project and explores the relationship between mathematics and physics as it looks at the effects of gravity, trajectory, and mass on an object's speed.

Related iLife Projects

- iMovie Projectile Project