Discovering the Story: A City and Its Culture

Applying Math to Music

Tiffany & Co. (1853-) Vase and Dedication Medallion, 1878
Silver
Bequest of Reuben R. Springer 1884.483

A Math Lesson for Grades 9-12 based on Vase and Dedication Medallion by Tiffany & Co.

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CONCEPT

In this musical lesson, students will understand the role mathematics plays in the composition of music. Students will learn and understand basic musical notation as it pertains to the study of mathematics. Teachers will then guide students in the application of previously gained mathematical skills to the production of an original musical composition.

The teacher will facilitate students in hands-on applications and study of the lesson's main objectives through pre-videoconferencing classroom activities, a videoconference visit with Cincinnati Art Museum Staff and post-videoconferencing lesson activities.

OBJECTIVES

- Students will understand the role mathematics plays in music composition.
- Students will learn and understand basic musical notations and their mathematical components.
- Students will apply previously gained mathematical knowledge and newly obtained musical notation skills in the creation of an original musical composition.

"Music is a magical gift we must nourish and cultivate in our children, especially now as scientific evidence proves that an education in the arts makes better math and science students, enhances spatial intelligence in newborns, and let's not forget that the arts are a compelling solution to teen violence, certainly not the cause of it!"

Michael Greene, Recording Academy President and CEO
at the 42nd Annual Grammy Awards, February 2000

Teacher Preparation

Class Periods Required

1 (30-50 min.) period for Pre-Lesson Activities
1 50-min. class period for Videoconference
1 (30-50 min.) period for Post-Lesson Activities
1 to 2 (30-50 min.) periods for Art Enrichment Activity (optional)

Background Information

Refer to Background Information for more on Reuben Springer and the Museum's *Vase and Dedication Medallion* and the company that created them. Background Information has been written for teachers to review before the lesson and then share with students and can be found on the website at http://www.discoveringthestory.org/goldenage/springer/background.asp

Video

Share the *Vase and Dedication Medallion* video with your students prior to the videoconference. The video, which is on the website at http://www.discoveringthestory.org/goldenage/springer/video.asp, is an interview with a Museum curator on Reuben Springer and the *Vase and Dedication Medallion*. This video is an excellent resource that will help to prepare students for the videoconference.

Video Duration – five minutes.

"Every child is an artist. The problem is how to remain an artist once he grows up."

Pablo Picasso

Pre- Videoconference

Vocabulary

Definitions can be found in the Glossary on the *Discovering the Story* website at http://www.discoveringthestory.org/goldenage/springer/glossary.asp.

Decimal
Fraction
Measure (Music)
Meter (Music)
Musical Note
- Whole Note
- Half Note
- Quarter Note
- Eighth Note
- Sixteenth Note

Percent
Rests
- Whole Rest
- Half Rest
- Quarter Rest
- Eighth Rest
- Sixteenth Rest

Time Signature

Guiding Questions

- How is math used in the composition?
- What is a time signature?
- How are music and math similar? How are they different?

Materials

- Reproduction of CAM *Tiffany & Co Vase and Dedication Medallion* downloaded from the website at http://www.discoveringthestory.org/goldenage/springer/images/springer_full.jpg
- *Musical Notation Reference Guide,* which can be found at the end of the lesson

PROCEDURE

Teacher will:

- Share with students the visual reproduction of the Museum's *Vase and Dedication Medallion.* Ask students to look at the pieces closely and describe what they see. Record all responses on the board.
- Share the Background Information on the Museum's *Vase and Dedication Medallion* with students. Upon reviewing the history of this vase, ask students why they think the artist included a lyre (harp) on the front of the vase. *Students should make the Music Hall connection; teachers are encouraged to lead them to this deduction.*
- Ask students who among them plays a musical instrument. Ask those students to share with the class how they know what kind of music to play when they play their instrument. They should all say that they read notes. Ask them to explain what notes are. Ask them the names of the different notes (whole note, half note, quarter note, etc.). Ask if they realized that when they play different notes, except for the whole note, they are actually playing a mathematical concept -- fractions.
- Tell students that today they are going to apply their mathematical skills to a study of music and musical notation. Pass out *Musical Notation Reference Guide* to students. ***Teacher Note****: For those students who play musical instruments, this introduction to musical notation may appear unnecessary. However it is important that these students, as well as the rest of the class, understand the mathematical skills used in musical notation and composition.*
- Using the *Musical Notation Reference Guide*, share the following basic musical notation with students, As each new component of musical notation is introduced, discuss with students the relations each has to mathematics.
    - A **Note** determines the length of time that the note is played by the musician. Students should understand that the length of a note is variable depending on the time signature. For example in 4/4 time:
        - A quarter note gets one beat
        - A half note gets two beats
        - A whole note gets four beats
        - An eighth note gets one half of one beat (half a quarter note)
        - A sixteenth note gets a quarter of one beat (quarter of a quarter note)
    - **A Dotted Note** (notes followed by a dot) represents one-and-a-half times the length of the same note without a dot. With the dot, the note keeps its original length and adds half of that original length. **For example, in 4/4 time:**
        - A half note is worth two beats. If that same half note is followed by a dot it is now worth three beats.
        - A whole note is worth four beats. If that same whole note is followed by a dot it is now worth six beats.
    - A **Rest** determines the length of time the musician rests or doesn't play. Students should understand that the length of a rest is variable depending on the time signature.
        - A quarter rest gets one beat
        - A half rest gets two beats
        - A whole rest gets four beats
        - An eighth rest gets one half of one beat (half a quarter rest)

    - A sixteenth rest gets a quarter of one beat (quarter of a quarter rest)

- **A Dotted Rest** (rests followed by a dot) represents one-and-a-half times the length of the same rest without a dot. With the dot, the rest keeps its original length and adds half of that original length. **For example, in 4/4 time:**
    - A half rest is worth two beats. If that same half rest is followed by a dot it is now worth three beats.
    - A whole rest is worth four beats. If that same whole rest is followed by a dot it is now worth six beats.
- Notes and rests are placed on a musical device known as a **Measure**. Each measure consists of a combination of notes and rests that equal a whole as dictated by the time signature. Much like a series of fractions equals a whole. Notes/rests are written either on the lines or in the spaces between the lines. The location of notes in a measure dictates pitch. *For this lesson students will not learn about pitch.*
- The **Meter** of a piece of music is its basic rhythm.
- A **Time Signature** appears at the beginning of a piece of music. The time signature is the symbol that tells the musician the meter of the piece. The time signature is written as a fraction, the top number or numerator represents the number of beats in one measure and the bottom number or denominator represents what type of note gets one beat. For example*:*
    - In **4/4** time, a measure will have 4 beats and the quarter note will get one beat.
    - In **2/2** time, a measure will have 2 beats and the half note gets one beat
- Emphasize student understanding by asking the music teacher to visit class to reinforce these concepts and their relation to mathematics.

Explain to students that they are now going to meet someone from the Cincinnati Art Museum and will learn more about the *Vase and Dedication Medallion.*

"Music has a great power for bringing people together. With so many forces in this world acting to drive wedges between people, it's important to preserve those things that help us experience our common humanity."
Ted Turner
Turner Broadcasting System

Videoconference

Objectives

- Students will interact with the Cincinnati Art Museum staff through a sixty-minute videoconference. Information on the videoconference is on the website at http://www.discoveringthestory.org/videoconference/.
- Students will learn about Cincinnati history from 1850 to 1900.
- Students will use Museum objects to reinforce activities completed in preparation for this videoconference.

Concept

A videoconference conducted by the Cincinnati Art Museum staff extends student learning through emphasis on the viewing and discussion of art objects. During this videoconference with the Museum, students will explore Cincinnati art history and the methods and practices of many of the artists working in the city.

Schedule

- **5 minutes** Introduction to CAM staff *(This is also buffer time in case of connection complications)*
- **10 minutes** Brief discussion of student pre-videoconferencing activities.
- **10 minutes** Museum staff will lead an interactive discussion with students on the history of Cincinnati from 1850-1900
- **20 minutes** Museum staff will lead students in an in-depth investigation of selected Museum objects.

Objects Include

- *Bedstead* by Benn Pitman, Adelaide Nourse Pitman, and Elizabeth Nourse. http://www.discoveringthestory.org/goldenage/images/bedstead_full.jpg
- *Reception Dress* by Selina Cadwallader. This image can be found at http://www.discoveringthestory.org/goldenage/images/dress_full.jpg
- *Aladdin Vase* by Maria Longworth Nichols Storer, which is available at http://www.discoveringthestory.org/goldenage/images/aladdin_full.jpg
- *Ali Baba Vase* by M. Louise McLaughlin, which is available at http://www.discoveringthestory.org/goldenage/images/alibaba_full.jpg
- *Vase and Dedication Medallion* by Tiffany & Co. This image is on the Website at http://www.discoveringthestory.org/goldenage/images/springer_full.jpg

- **10 minutes** Questions and student sharing of art projects.

- **5 minutes** Closing *(This is also buffer time in case of connection complications)*

POST – VIDEOCONFERENCE

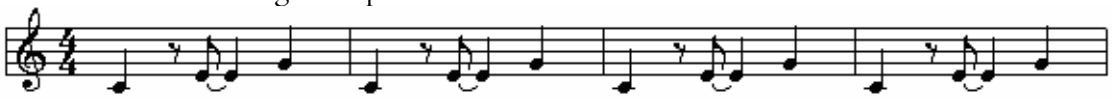
MATERIALS

- Reproduction of CAM *Tiffany & Co Vase and Dedication Medallion*
- *Musical Notation Reference Guide*, which can be found at the end of the lesson.
- *Musical Composition Worksheet,* which follows the guide at the end of the lesson

PROCEDURE

Teacher will:

- Review with students what they learned during the videoconference with the Museum; students should be more aware of the history of not only the *Vase and Dedication Medallion*, but also the city of Cincinnati.
- Review musical notation, specifically time signatures, with students; their understanding of this aspect of musical notation is vital to their success in creating their compositions.
  - For practice, write the following time signatures on the board: **4/4 2/2 3/4 3/8**
  - With students, create a measure of each using a variety of notes and rests. Students should use their mathematical skills to combine note/rest values into a complete whole as dictated in the time signature.
    - Write the following example on the board:



The time signature is 4/4, which means that there are four beats in each measure and the quarter note gets one beat. In this line of music, the composer used quarter notes to represent each beat, and each measure contains four quarter notes.

- **Another example:**

The time signature is 3/8, which means that there are three beats in each measure and the eighth note gets one beat. In this line of music, the composer used a variation of eighth, sixteenth, quarter and dotted quarter notes to represent the three beats in each measure.

- Pass out copies of the *Musical Composition Worksheet* to students. Tell students that they are now going to create their own musical compositions using several different time signatures. Each student will write eight lines of music for each of the following time signatures: **4/4, 2/2, 3/4, 3/8.** Students should be encouraged to use their creativity and use various combinations of notes and rests in their compositions.

Assessment Objectives

- Students understand the role mathematics plays in music composition.
- Students understand basic musical notation and their mathematical components.
- Students create an original musical composition using a variety of time signatures and note/rest combinations.

"The nation's top business executives agree that arts education programs can help repair weaknesses in American education and better prepare workers for the 21st century."

"The Changing Workplace is Changing Our View of Education."
Business Week, October 1996

National Academic Content Standards

Mathematics

Standard 9: Understands the general nature and uses of mathematics.

Grades: 9-12

Benchmark 7: Understands that mathematics provides a precise system to describe objects, events and relationships and to construct logical arguments.

Visual Arts

Standard 4: Understands the visual arts in relation to history and cultures.

Benchmark 1: Knows a variety of historical and cultural contexts regarding characteristics and purposes of works of art.

Benchmark 2: Knows the function and meaning of specific art objects within varied cultures, times and places.

Benchmark 3: Understands relationships among works of art in terms of history, aesthetics and culture.

Music

Standard 5: Reads and notates music.

Benchmark 2: Reads music that contains moderate technical demands, expanded ranges and varied interpretive requirements.

"I would teach children music, physics, and philosophy; but most importantly music, for in the patterns of music and all the arts are the keys of learning."

Plato

Ohio Academic Content Standards

Mathematics

Mathematical Processes: Students use mathematical processes and knowledge to solve problems. Students apply problem-solving and decision-making techniques, and communicate mathematical ideas.

Grades 8-10

Benchmark B: Applies mathematical knowledge and skills routinely in other content areas and practical situations.

Visual Arts

Historical, Cultural and Social Contexts: Students understand the impact of visual art on the history, culture and society from which it emanates. They understand the cultural, social and political forces that, in turn, shape visual art communication and expression. Students identify the significant contributions of visual artists to cultural heritage. They analyze the historical, cultural, social and political contexts that influence the function and role of visual art in the lives of people.

Grade 9-12

Benchmark A: Explains how and why visual art forms develop in the contexts (e.g., cultural, social, historical and political) in which they were made.

"The US Department of Labor issued a report urging schools to teach and prepare children entering in the future workplace. The skills they recommend (working in teams, communication, self-esteem, creative thinking, imagination and invention) are exactly those learned in school music education programs."

Goals 2000: Educate America Act

Musical Notation Reference Guide

Notes:

 Quarter Note

 Eighth Note

 Whole Note

 Half Note

 Sixteenth Note

Rests:

 Quarter Rest

 Whole Rest

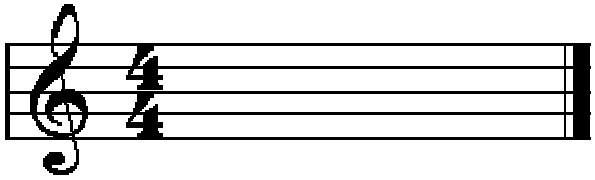
 Half Rest

 Eighth Rest

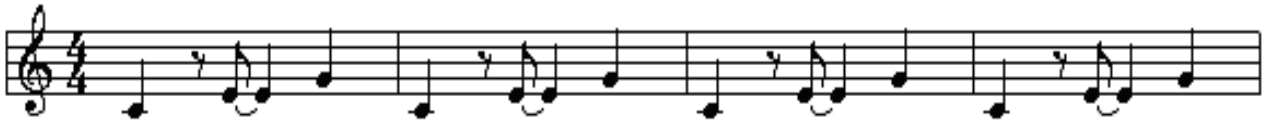
 Sixteenth Rest

Measures:

Time Signature:



Example of a Line of Music:



Musical Composition

Name: _____