BALLET ARIZONA
IB ANDERSEN ARTISTIC DIRECTOR

Student Matinee Study Guide

ARTS INTEGRATION LESSON – DANCE AND SCIENCE

LESSON TITLE: FORCE IN MOTION

Academic subject(s): Science (Physics)	**Art form(s):** Dance (Ballet)	**Name:**		
		City:		
		Grade(s):	**Date:**	**Duration:**

STANDARDS AND OBJECTIVES

Academic Standard(s):

Next Generation Science standards:

(www.nextgenscience.org) Variations of the lesson plan are provided for differentiation. Additional variations can be created using the same arts integration strategies to address all of the following standards:

5 Dimension 3: Discipline Core Ideas – Physical Science

- Matter and its interactions
- Motion and stability
- Forces and interactions

Crosscutting Concept 5 – Energy and Matter

Flows, cycles, and conservation. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.

Crosscutting Concept 7 – Stability and Change

For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

Arizona Science Standards:

(http://www.azed.gov/standards-practices)

Strand 5: Physical Science – Concept 2

- K-4: Position and Motion of Objects – understand spatial relationships and the way objects move.
- 5-8: Motion and Forces – understand the relationship between force and motion.
- HS: Motion and Forces – analyze relationships between forces and motion.

Arts Standard(s):

(http://www.azed.gov/standards-practices/art-standards/)

Strand 1 (create)

- **Concept 1 – Body**
  Identify, demonstrate and analyze the use of the body for dance through an understanding of anatomy, kinesiology and basic movement principles.
- **Concept 2 – Movement Skills**
  Identify, demonstrate and analyze basic movement skills in the exploration and performance of dance.
- **Concept 4 – Improvisation/Choreography**
  Identify, demonstrate, analyze and apply improvisational structures, choreographic processes, forms and principles.

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Performance Objectives:

Upon completion of the lesson, students will be able to:

- Analyze physics in motion during a dance performance.
- Discuss the relevance of physics in relation to movement.
- Articulate the different physics concepts through their bodies.
- Collaborate to create models that demonstrate their understanding of physics.
- Explain their process and product demonstrating metacognition and understanding of physics.

Key Vocabulary:

space, time, energy, force, motion, weight sharing

*Additional physics vocabulary will vary with each grade level and the specific concepts they are working with.

21st Century Skills: critical thinking, creativity/innovation, problem solving, teamwork/collaboration

ART SUPPORT

Foundational Knowledge Needed for Lesson:

When sharing weight, it is important to establish safety precautions with students. Discussion about trust and "equally distributed weight" is helpful in this area. The goal is not to overpower each other, but rather to find stable balance through tension and resistance. Modeling safe weight sharing from the teacher with a student volunteer is also helpful.

ENVIRONMENT / LEARNING ZONE

Materials/Resources:

- CD player and instrumental music
- Loose fitting clothing that accommodates movement

Room Setup:

If there is flexibility in the arrangement of furniture in your classroom, consider how everything can be organized to foster collaboration and movement exploration. Otherwise, every empty nook and cranny can be used, including the aisles between tables or desks.

PROCEDURES

Pre-Performance Inquiry Activity:

Engage students in an interactive discussion about the elements of physics such as space, time, energy, force, motion, etc. This can be achieved by asking them to create a non-verbal symbol (such as a gesture or simple sketch) of what they know about a given concept. Have the students share through a quick buddy buzz experience (pairing students for 1-2 minute discussions) their connections of their non-verbal symbols to the respective element of physics.

Use "freeze dance", a simple movement-based game, to direct the students to explore movement concepts such as spinning, jumping, locomotion (moving from point A to B), and so forth. Freeze dance is an improvisational structure that when the music is playing, the students can dance and move. When the music stops, the students freeze. In this scenario, instead of allowing students to move freely, they are limited to the specific type of movement as directed by the teacher. *As an added challenge, the students can be directed to use the non-verbal symbols (if movement-based) they created in the preliminary discussion.

Facilitate a discussion of how the movements explored in "freeze dance" are related to (and are manifestations of) the concepts in physics that were first discussed. Encourage students to connect physics to their observations during the live dance performance.

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Post-Performance Focused Engagement:

After the dance performance, share observations. Discuss both the simplicity and the complexity of what was observed in the live performance. Compare and contrast the movements performed on stage to the movement the students themselves created.

1. Divide the class into pairs and have the students engage in simple weight sharing exercises. In partners, and always maintaining at least 1 point of contact, the students will:
   - **a.** PULL away from each other to find stable balance (counterbalance)
   - **b.** PUSH into each other to find stable balance
2. After they are comfortable with this, have each pair explore, discover, and establish at least 4 different shapes that are formed either through PULL or PUSH, and have them remember both the final shapes and the process, specifically if they discovered moments of unevenness or loss of balance.
3. Choose a specific element of physics, and use it as a restriction to how the students execute their shapes. (This can also be student selected.) For example:
   - **a.** TIME—a time restriction (10 seconds or 60 seconds)
   - **b.** MOTION—to remain stationary or to travel
   - **c.** CANTILEVER—redirection of force through tension
4. Each pair shares their shapes for the class, followed by a discussion that includes explanation of process and applications to physics.
5. Repeat steps 3 and 4 with the following variation: Have individual pairs team up into groups of 4 or 6 and use Push or PuLL to find a way to connect their individual movements to create larger shapes.
6. Facilitate a discussion on the physical, tangible, and tactile presence of force and how that was embodied in movement.

Skillful Assessment:

The set of shapes that each pair of students creates is already an artifact of this learning. As an added assessment exercise, have individual pairs team up into groups of 4 and have each pair teach the other the process of their movement and how it relates to physics.

Continuing Inquiry:

Many forces in the physical world are imperceptible. For example, gravity is not just the earth's physical pull on objects, but is also found between objects. Using a similar movement strategy, have students use their counterbalanced shapes and then challenge them to execute the choreography, but without any physical contact as a representation of invisible forces and the constant interconnectivity that is everywhere.

REFLECTIVE PRACTICE

Students:

- How did the use of weight sharing in the model demonstrate the concept of _____?
- How do you know?
- How does physics impact the way our body moves?
- How did weight sharing help you in understanding _____ (concept in physics)?
- What was your group process for using weight sharing to design the model?
- What, if any, additional informational does the audience need to know to understand the model?
- What do you want to know next about the _____ (concept in physics)?

Teachers:

- How did the performance provide an opportunity for students to observe and analyze physics in motion?
- In what ways did this lesson help students engage with physics and understand its relevance?
- In what ways did the students articulate the different concepts present in physics through their bodies?
- How did the weight sharing deepen students' understanding of physics?
- How did the students work collaboratively to create the weight sharing shapes?
- How did students' discussion after each sharing demonstrate their understanding of physics?
- How did this lesson work for you? How would you change the lesson to make it more effective?