

## ARTS IMPACT LESSON PLAN

### Dance and Math Infused Lesson

#### Lesson One: *Functions and Choreographic Devices with the Gumboot Dance*

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#### Enduring Understanding

A function is a specific type of relationship in which each input has a unique output. A function rule can represent the change in one quantity or movement pattern that causes a corresponding change in another quantity or movement pattern. Choreographers can use functions to add variety to dances.

#### Lesson Description (Use for family communication and displaying student art)

*In this dance and math lesson, students learn patterns from the Gumboot Dance from South Africa. Using the choreographic device of accumulation, they add a pattern with every repetition. The class creates a table to show how increasing the counts with each repetition affects the total number of counts. They analyze the function rule that describes the change and check their work by dancing the dance.*

### Learning Targets and Assessment Criteria

**Target:** Learns a world dance.

**Criteria:** Dances the Gumboot Dance.

**Target:** Demonstrates accumulation.

**Criteria:** Dances variation one. Dances variation one and variation two. Dances variations one, two, and three. Dances variations one, two, three, and four.

**Target:** Analyzes the function rule of the accumulation pattern in the world dance.

**Criteria:** Increases the number of counts by eight in each repetition of the dance.

#### Vocabulary

Arts Infused:  
Pattern

Math:  
Function  
Input  
Output

Arts:  
Accumulation  
Choreographic Device  
Choreography  
Repetition  
Steps  
Variations

#### Materials

##### Museum Artworks or Performance

##### Seattle, WA

Pacific Northwest Ballet  
UW World Series of Dance

##### Tacoma, WA

Broadway Center for the Performing Arts

##### Materials

*Middle School Math Dances* CD by Debbie Gilbert; White board, document camera, or chart paper & markers; Computer with internet connection and projector; Class Assessment Worksheet; Music player

Music:  
"Middle School BrainDance," *Middle School Math Dances* by Debbie Gilbert

Video:  
Gumboot Dancers in Cape Town:  
<http://www.youtube.com/watch?v=iSgFAG0mtac>

#### Learning Standards

##### WA Arts State Grade Level Expectations

For the full description of each WA State Arts Grade Level Expectation, see:

<http://www.k12.wa.us/Arts/Standards>

- 1.1.1 Elements: Space
- 1.1.2 Elements: Time, Rhythm
- 1.1.4 Principles of Choreography: Repetition, Variety
- 1.2.1 Skills and Techniques: Uses Abdominal Muscular Control in Movement
- 1.4.1 Audience Skills
- 2.1.1 Creative Process
- 2.2.1 Performance Process
- 2.3.1 Responding Process
- 4.2.1 Connection between Dance and Math
- 4.4.1 Cultural/Historical Connection

##### Common Core State Standards (CCSS) in

**Math** For a full description of CCSS Standards by grade level see:

<http://www.k12.wa.us/CoreStandards/Mathematics/default.aspx>

- 8.F. Define, evaluate, and compare functions.

*continued*

8.F.1. Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.

**CCSS Mathematical Practices**

MP.2. Reason abstractly and quantitatively.

MP.4. Model with mathematics.

MP.8. Look for and express regularity in repeated reasoning.

### ICON KEY:

 = Indicates note or reminder for teacher

 = Embedded assessment points in the lesson

### Pre-Teach

Introduce functions. Create function tables for a variety of contexts. Determine function rules. Set expectations for physical and emotional safety for dancing. Note: This lesson is designed as an introductory functions experience.

### Lesson Steps Outline

1. Introduce using functions to analyze a dance.
2. Show video of the Gumboot Dance.
3. Define expectations for movement.
4. Lead students in the *Middle School BrainDance* warm-up.  
Music: "Middle School BrainDance," *Middle School Math Dances* by Debbie Gilbert

5. Teach the Gumboot Dance.

 Criteria-based teacher checklist: Dances the Gumboot Dance.

6. Add accumulation to the Gumboot Dance.

 Criteria-based teacher checklist, self-assessment: Dances variation one. Dances variation one and variation two. Dances variations one, two, and three. Dances variations one, two, three, and four.

7. Create a table to show the input and output when accumulation is used. Ask students to determine the function rule.

 Criteria-based process assessment: As a class, creates a function table representing the inputs and outputs of the accumulation of the dance. Determines the function rule:  $x + \text{eight}$ .

8. Repeat the dance to check our mathematical work.

 Criteria-based teacher checklist, peer assessment: Dances variation one. Dances variation one and variation two. Dances variations one, two, and three. Dances variations one, two, three, and four. Increases the number of counts by eight in each repetition of the dance.

**9. Lead reflection.**

Criteria-based reflection: Makes a connection between dance and math.

## LESSON STEPS

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### 1. Introduce using functions to analyze a dance.

- *Dancing Mathematicians, today we will learn a dance from South Africa called the Gumboot Dance.*
  - *Then we will use a choreographic device to alter the dance. A choreographic device is a technique a dance inventor uses to change a dance.*
  - *We'll create a function table to analyze the changes.*
  - *Remind me, what is a function (e.g. a rule that uniquely associates elements of one set with elements of another set; a relationship in which a change in one thing causes a corresponding change in another thing; a relationship in which each input has a unique output)?*
  - *As we dance, think about how a choreographer, a dance inventor, could use functions in creating dances.*
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### 2. Show video of the Gumboot Dance.

▣ There are multiple versions of the Gumboot Dance on YouTube. Review them and select the one you feel would work best for your students. Here is an example:

Gumboot Dancers in Cape Town:

<http://www.youtube.com/watch?v=iSgFAG0mtac>

- *The Gumboot Dance was originated by gold miners during the apartheid era of South Africa. Miners were forced to work under harsh and dangerous conditions. Mines often were flooded and since it was cheaper than draining the water, the bosses had the workers wear rubber boots (gumboots) to protect their skin from constant exposure to the water.*
  - *The workers were chained together and not allowed to speak to each other so they communicated by making rhythms and beats with their bodies and their gumboots. That became the Gumboot Dance.*
  - *After apartheid, the dance became popular and inspired many other dance forms like stepping.*
  - *After we have watched the video, let's take a few moments to discuss the movement we saw.*
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### 3. Define expectations for movement.

- *When you are dancing, I expect you to be focused and to be respectful of each other and of yourself as a dancer.*
  - *Keep empty space around yourself at all times and keep your eyes open and your body under control.*
  - *Have fun and learn simultaneously!*
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**4. Lead students in the *Middle School BrainDance* warm-up.** (BrainDance originally developed by Anne Green Gilbert, [www.creativedance.org](http://www.creativedance.org), reference: *Brain-Compatible Dance Education*, video: *BrainDance, Variations for Infants through Seniors*.)

Music: "Middle School BrainDance," *Middle School Math Dances* by Debbie Gilbert

▣ In the BrainDance music, you will hear the title of each pattern spoken. The prompts below are suggestions if you would like to give the students more detail. You can also adapt the prompts to meet the needs of your students and the lesson. If you prefer to have the prompts spoken for you, you can use the "Middle School BrainDance with narration."

▣ You could choose to use accumulation in the BrainDance (i.e. adding a new movement with each repetition) to introduce the concept, or you could focus on the BrainDance as a physical warm-up without adding accumulation.

- *Before we start moving, we are going to do a BrainDance to warm-up our brains and bodies in preparation for learning the dance.*
- *The BrainDance will take us through a series of patterns that help to wire the central nervous system. The movement will increase oxygen and blood flow to your brain and body, and help with balance, alignment, and coordination.*

### **Breath**

- *Dancing Mathematicians, breathe quietly.*

### **Tactile**

- *Energize the surface of your body, tapping from your head to your toes.*

### **Core-Distal**

- *Expand from your core into a large shape, reaching to the limits of your distal edges.*
- *Shrink into a small shape pulling everything back towards your core.*

### **Head-Tail**

- *Curl your spine forwards and backwards and forwards and backwards.*
- *Curve from side to side.*

### **Upper Half**

- *Freeze the lower half of your body. Move the upper half.*

### **Lower Half**

- *Freeze the upper half of your body. Move the lower half.*

### **Body-Half Right**

- *Dance with your whole right side while the left side is frozen.*

### **Body-Half Left**

- *Dance with your whole left side while the right side is frozen.*

### **Cross-Lateral**

- *Reach across your body with your arms on different levels.*

### **Vestibular**

- *Turn. Freeze in a shape. Turn. Freeze in a shape. Turn. Freeze in a shape. Turn. Freeze in a shape.*

## Breath

- *Breathe quietly, Dancing Mathematicians.*
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### 5. Teach the Gumboot Dance.

▣ The counts are listed in parentheses below (e.g. one, and, two, and, three, and...).

- *We'll learn four different variations of the Gumboot Dance.*
- *For the first variation, just stomp in place, swinging your leg slightly from side to side with each step. Start with your left foot and do eight stomps. (one, two ... eight)*

▣ Practice variation one.

- *Here's the second variation: basic stomping and boot slapping. Bend your knees and lean slightly forward.*
- *Stomp with your left foot (one).*
- *Lift your right foot and slap the outside of your right "boot" (and).*
- *Stomp with your right foot (two).*
- *Lift your left foot and slap the outside of your left "boot" (and).*
- *Repeat, starting with the left foot, then the right, left, right, left, right (three, and, four, and, five, and, six, and seven, and eight, and).*

▣ Practice variation two.

- *Here's the third variation: stomp, clap, slap.*
- *Stomp with your left foot and lift your right foot and clap at the same time (one).*
- *Slap the inside of your right heel with your right hand (and).*
- *Stomp with your right foot and lift your left foot and clap at the same time (two).*
- *Slap the inside of your left heel with your left hand (and).*
- *Repeat for a total of eight counts.*

▣ Practice variation three.

- *The fourth variation is dancer's choice. Create your own combination of stomps, slaps, and claps. Repeat it for a total of eight counts.*

▣ Give students time to create and practice their variations. They could plan their movements or just do them freestyle.

Criteria-based teacher checklist: Dances the Gumboot Dance.

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### 6. Add accumulation to the Gumboot Dance.

▣ When assessing the criteria in this lesson, any students who are not meeting criteria will be very clear to you, so you may want to use a reverse checklist, putting a “0” where students have not met criteria, rather than trying to note every single one who has met criteria. You can go back later and give those who have met criteria a “1.” This information will let you know who needs more practice, so you can repeat the exploration in the future.

- *Now that you know four variations of the Gumboot Dance, let’s add accumulation.*
- *Accumulation is a choreographic device in which new movements are added to existing movements in succession.*
- *So you would do the first movement or variation. Then you would do the first and second. Then you would do the first, second, and third. Then the first, second, third, and fourth.*
- *We’ll do the Gumboot Dance adding one variation each time.*
- *Let’s dance variation one. That’s the first eight counts.*
- *Dance variation one, and add variation two. That’s the first eight counts plus the second eight.*
- *Dance variation one, variation two, and add variation three. That’s sixteen counts plus the next eight.*
- *Dance variation one, variation two, variation three, and add variation four. That’s twenty-four counts plus the next eight.*
- *Ask yourself, did you add one pattern every time you repeated the dance?*

☑ Criteria-based teacher checklist, self-assessment: Dances variation one. Dances variation one and variation two. Dances variations one, two, and three. Dances variations one, two, three, and four.

**7. Create a table to show the input and output when accumulation is used. Ask students to determine the function rule.**

- *Let’s analyze our dance mathematically.*
- *Help me create a table that represents the accumulation in our dance.*
- *For the input, we’ll write the number of counts before we add each of the four variations. To begin we have zero.*
- *For the output, we’ll write the number of counts we have done when we finish each variation. Since the first variation is eight counts long, our output is eight.*
- *Before we add variation two, we have 8 counts. That’s our input. What’s our output when we have finished variation two? How do you know?*

Gumboot Dance Variations	input	output
Variation one	0 counts	8 counts
Variation two	8 counts	? counts
Variation three	? counts	? counts
Variation four	? counts	? counts

▣ Continue to fill in the table with student suggestions. It might look something like this:

Gumboot Dance Variations	input	output
Variation one	0 counts	8 counts
Variation two	8 counts	16 counts
Variation three	16 counts	24 counts
Variation four	24 counts	32 counts

- *Is this a function? Why or why not?*
- *What is the function rule? (e.g.  $x + 8$ )*
- *How do you know?*

☑ Criteria-based process assessment: As a class, creates a function table representing the inputs and outputs of the accumulation of the dance. Determines the function rule:  $x + \text{eight}$ .

## 8. Repeat the dance to check our mathematical work.

- *Let's do the Gumboot Dance with accumulation again to check our function table for accuracy. Notice the inputs and the outputs.*
- *We'll need someone to help us count our repetitions.*
- *Dance variation one. (Counting assistant counts: 1, 2, 3 ... 8.)*
- *Dance variation one and variation two. (Counting assistant counts: 1, 2, 3 ... 16.)*
- *Dance variation one and variation two and variation three. (Counting assistant counts: 1, 2, 3 ... 24.)*
- *Dance variation one and variation two and variation three and variation four — your own pattern or freestyle. (Counting assistant counts: 1, 2, 3 ... 32.)*
- *Did our dance match our function table? Why or why not?*

☑ Criteria-based teacher checklist, peer assessment: Dances variation one. Dances variation one and variation two. Dances variations one, two, and three. Dances variations one, two, three, and four. Increases the number of counts by eight in each repetition of the dance.

## 9. Lead reflection.

- *All of our inputs and outputs were even numbers. What would happen if the choreographer had chosen to use odd numbers?*
- *Dancing Mathematicians, what did you discover about functions by dancing?*
- *Why do we use functions? Why are they useful?*
- *Now that you have used functions in movement, how and why do you think dancers and choreographers use them in creating and learning dances?*

- *The next time you use functions in math, remember how you danced them and it will help you.*

Criteria-based reflection: Makes a connection between dance and math.

**Extensions:**

Develop function rules for dances that use the choreographic device of accumulation in a more complex way (e.g.  $mx + b$ ).

Develop function rules for dances that use the choreographic device of diminution in which you reduce the movement phrase each time you repeat it.

**ARTS IMPACT LESSON PLAN Dance and Math Infusion**

Eighth Grade Lesson One: *Functions and Choreographic Devices with the Gumboot Dance*

Teachers may choose to use or adapt the following self-assessment tool.

**STUDENT SELF-ASSESSMENT WORKSHEET**

Disciplines	DANCE	DANCE				MATH/DANCE	Total 6
Concept	World Dance	Accumulation				Functions	
Criteria	Dances the Gumboot Dance.	Dances variation one.	Dances variation one and variation two.	Dances variations one, two, and three.	Dances variations one, two, three, and four.	Increases the number of counts by eight in each repetition of the dance.	
Student Name							

**ARTS IMPACT LESSON PLAN Dance and Math Infusion**

Eighth Grade Lesson One: *Functions and Choreographic Devices with the Gumboot Dance*

**CLASS ASSESSMENT WORKSHEET**

Disciplines	DANCE	DANCE				MATH/DANCE	Total 6
Concept	World Dance	Accumulation				Functions	
Criteria Student Name	Dances the Gumboot Dance.	Dances variation one.	Dances variation one and variation two.	Dances variations one, two, and three.	Dances variations one, two, three, and four.	Increases the number of counts by eight in each repetition of the dance.	
1.							
2.							
3.							
4.							
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23.							
24.							
25.							
26.							
27.							
28.							
29.							
30.							
Total							
Percentage							

*What was effective in the lesson? Why?*

*What do I want to consider for the next time I teach this lesson?*

*What were the strongest connections between dance and math?*

Teacher: \_\_\_\_\_

Date: \_\_\_\_\_

### DANCE AND MATH LESSON: *Functions and Choreographic Devices with the Gumboot Dance*

Dear Family:

Today your child participated in an **Arts and Math** lesson. We talked about functions and how choreographers can use functions when they create dances.

- We discovered that a function is a relationship in which a change in one thing causes a corresponding change in another thing.
- We learned the Gumboot Dance from South Africa.
- We added accumulation to our dance. That means that we did the first part of the dance. Then we did the first and second parts of the dance. Then we did the first, second, and third parts of the dance, and, finally, the first, second, third, and fourth parts of the dance.
- We made a table with the inputs (the number of counts before we added each of the four variations) and the outputs (the number of counts when we finish each variation).
- We figured out the function rule — increase by eight.
- We did the dance again to check our work.

At home, you could look for examples of functions, like the miles per gallon in a car, or how much your child would have if he/she saved an allowance for two weeks, four weeks, or two months. Ask your child to teach you the Gumboot Dance and to tell you how you could use functions in a dance.

### **Enduring Understanding**

A function is a specific type of relationship in which each input has a unique output. A function rule can represent the change in one quantity or movement pattern that causes a corresponding change in another quantity or movement pattern. Choreographers can use functions to add variety to dances.