LESSON OBJECTIVE
Students will understand the concept of congruence in terms of rigid motions through dance choreography.

ESSENTIAL QUESTIONS
How are rigid motions and dance study related?

21st CENTURY SKILLS:
✓ Critical Thinking  ✓ Creative Thinking  □ Collaborating  □ Initiative
✓ Communicating  □ Media Literacy  □ Informational Literacy
□ Tech Literacy  □ Flexibility  ✓ Social Skills
✓ Leadership  □ Productivity

CONTENT STANDARDS
CCSS.MATH.CONTENT.HSG.CO.B.6

Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.

ARTS STANDARDS
DA:Cr1.1.I

Explore a variety of stimuli for sourcing movement to develop an improvisational or choreographed dance study.
LESSON OVERVIEW

Congruence has always meant same size and shape in the world of Geometry. When the Common Core standards were introduced, that definition expanded so that students understand congruence in terms of rigid motion. Basically, if you move a figure through translation, rotation or reflection, the figure does not change shape or size. Students should be able to perform those transformations and decide if figures are congruent or not.

ENGAGEMENT

Share the following image with students.

Guiding Questions for Discussion:
What do you notice and wonder?

What is the story here?

Which is the original triangle? How do you know?

How can you get from one triangle to the other?

What would happen if you moved the triangles so that they were in the same location?
STEP 1

Jigsaw Notes on Transformations and Congruence

Split students up into four groups. The groups will be experts on translation, reflection, rotation and congruence. If you have a larger class, you could always do eight groups, two of each expert type group.

Each expert group can use the internet or their textbook to fill out the Frayer model for their type of transformation (See the resource document).

After a given amount of time, groups will share out their information. Another option is to send out a member from each group to gather information and report back to their original group.

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Artful Thinking Routine (10 mins)

Beginning/Middle/End. Have students analyze Fire Diver by John Steuart Curry, 1934

Choose one of these questions:

If this artwork is the beginning of a story, what might happen next?

If it this artwork is the middle of a story, what might have happened before? What might be about to happen?

If this artwork is the end of a story, what might the story be?

Artful Thinking by Project Zero is licensed under a Creative Commons AttributionNonCommercial 4.0 International License. Routine found here: http://pzartfulthinking.org/

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STEP 2

Dance Connections

Have a discussion about the elements of dance with students and what they think they mean (body, action, space, time, energy). After the discussion, pass out the handout on the elements of dance.

Let students know that they are about to watch a dance video. Assign students a specific element of dance to be aware of. Give some students the mathematical vocabulary learned in the previous activity to be aware of. Show the following video of the Dance of the Sugar Plum Fairy (2010). See the resource document for a note-taking guide for students to complete while watching.
After students have watched the video and completed the note-taking guide, guide a class discussion on what they noticed. **Guiding questions:** Which elements of dance do you think appeared the most? Which transformations appeared the most? For those elements that you didn’t see, how could the dancer have incorporated them into her routine? For those transformations that you didn’t see, how could the dancer have incorporated them into her routine? Do you think there could be reasons why not all elements were included in this particular routine? Would it be good or bad to include all of the mathematical transformations we’ve learned today?

If there is enough time, students could find their own videos and analyze them based on the elements of dance and the mathematical transformations. This could also be a good homework assignment.

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**Teacher-to-Teacher**

Equity-sticks can be a great resource when having classroom discussions to make sure that everyone is contributing to the conversation. You can also have students write their answers on small slips of paper and read some of them randomly to get the conversation started.

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**Main Activity/Project**

The main activity for students is creating their own dance routine to perform for the class. Ideally, students should work in groups of 4-6. When creating their dance study, they should be utilizing the elements of dance and incorporating the mathematical transformations they learned in the jigsaw lesson.

Before students start, it might be a good idea to help them brainstorm different body actions that they could include in their performance. Students should use the handout on the elements of dance to assist them in choreographing their dance study. Students may pick their own music, but it is suggested that you pick a short instrumental track that could work for all student performances. This would save student planning time and save you time from previewing all of their musical selections.

There is a feedback checklist below for the teacher to provide feedback to the students. The rubric should be shared with students ahead of their group work so that they know what is expected of them.

**ESTIMATED TIME:** 20 minutes to create and 20 minutes for groups to perform
CLOSURE

Reflection and Discussion

Students should go back to their notes they took while watching the dance video. Zoning back in on their area of focus, they should reflect on this element comparison to their choreographed dance. Was this element natural to incorporate? The teacher can use this opportunity to discuss what students learned about Geometry and Dance and how the two areas relate.
Use the rubric below to provide feedback, both positive and constructive, to the student after they perform their group dance.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>★/✓/☹</th>
<th>Notes/Feedback</th>
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<tbody>
<tr>
<td>All members of the group participated in the dance</td>
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<tr>
<td>All 5 math terms discussed (congruence, rigid motion, rotation, reflection and translation) were seen in the dance and interpreted correctly</td>
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<tr>
<td>All 4 elements of dance (body, energy, time and space) were seen in the dance with variety and intention</td>
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<tr>
<td>Group was focused and cohesive during their dance</td>
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<td>Group members worked collaboratively (participating in decisions, listening to others and contributing ideas)</td>
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<tr>
<td>Definition in your own words</td>
<td>Real World Example(s)</td>
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<td>Translation</td>
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<tr>
<td>Mathematical Examples</td>
<td>Non-examples</td>
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<td>Rigid Motion</td>
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Dance Video Note-taking guide

My thoughts

My focus is:

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THE ELEMENTS OF DANCE

**MOVEMENTS**

**Locomotor:** Movement through space from one point to another (walk, run, jump, hop, leap, skip, gallop, slide, roll)

**Non-Locomotor:** Movement around the body's axis (bend, twist, stretch, push, pull, swing, shake, circle, sway, carve, fall, melt, turn, kick, press, rise, sink, burst, wiggle)

**BODY**

**Shape:** A frozen pose (curves, straight, angular, twisted, narrow, wide, symmetrical, asymmetrical)

**Part:** Body parts (head, eyes, torso, shoulder, arms, fingers, elbows, hands, hips, legs, knees, feet, ankles, etc)

**SPACE**

**Shelf Space:** Space immediately around the body

**General Space:** Space throughout the room

**Level:** High, medium or low

**Direction:** Forward, backward, sideways, up, down

**Pathway:** Curved, straight, zigzag, diagonal

**Size:** Big, small, narrow, wide

**Focus:** Direction of gaze

**TIME**

**Tempo:** Fast, medium, slow

**Rhythm:** A succession of movement or sounds of various duration

**ENERGY**

**Weight:** Strong (heavy, firm, powerful), light (gentle, soft)

**Flow:** Free (continuous, fluid movement), bound (restrained, controlled)

**Quality:** Sharp, sudden, smooth, sustained, tight, loose, suspended, collapsed, heavy, weak, percussive