

Title of Unit	SHAPE AND SPACE (TRANSFORMATIONS)	Grade Level	7-9
Curriculum Area	Mathematics	Time Frame	7 lessons
Developed By	Kanwal Neel		
Identify Desired Results (Stage 1)			
Content Standards			
NCTM Geometry 9-12			
<ul style="list-style-type: none"> • Understand and represent translations, reflections, rotations, and dilations of objects in the plane by using sketches, and coordinates. • Use various representations to help understand the effects of simple transformations and their compositions. • Use geometric ideas to solve problems in, and gain insights into, other disciplines and other areas of interest such as art and architecture. <p style="text-align: right;">(NCTM, 2000, p. 308)</p>			
WNCP Specific Outcomes			
<ul style="list-style-type: none"> • Classify a given set of 2-D shapes or designs according to the number of lines of symmetry. • Complete a 2-D shape or design given one half of the shape or design and a line of symmetry. • Determine if a given 2-D shape or design has rotation symmetry about the point at the centre of the shape or design and, if it does, state the order and angle of rotation. • Rotate a given 2-D shape about a vertex and draw the resulting image. • Identify a line of symmetry or the order and angle of rotation symmetry in a given tessellation. • Identify the type of symmetry that arises from a given transformation on the Cartesian plane. • Complete, concretely or pictorially, a given transformation of a 2-D shape on a Cartesian plane, record the coordinates and describe the type of symmetry that results. • Identify and describe the types of symmetry created in a given piece of artwork. • Determine whether or not two given 2-D shapes on the Cartesian plane are related by either rotation or line symmetry. • Draw, on a Cartesian plane, the translation image of a given shape using a given translation rule, such as R2, U3 or label each vertex and its corresponding ordered pair and describe why the translation does not result in line or rotation symmetry. • Create or provide a piece of artwork that demonstrates line and rotation symmetry, and identify the line(s) of symmetry and the order and angle of rotation. • Draw and construct representations of two- and three-dimensional geometric objects using a variety of tools. <p style="text-align: right;">[C, CN, PS, V] (WNCP, 2006, p. 156)</p>			
BC Social Studies Grade 7			
<ul style="list-style-type: none"> • connections between ancient and contemporary cultures • cultural adaptation and preservation <p style="text-align: right;">(http://www.bced.gov.bc.ca/irp/ssk7/planning.htm)</p>			

Enduring Understandings <i>Students will understand that:</i>	Essential Questions
<ul style="list-style-type: none"> • Transformations (translations, reflections, rotations, and dilations) are all around us. • Transformations provide the framework for artistic representation in many cultures. • Transformations are imbedded in the design of blankets, and other art in many different cultures, including the Haida Button Blanket. • Mathematical properties of rotations, reflection, and symmetry are found in many designs in everyday life. 	<ul style="list-style-type: none"> • How are logos and crests linked to the sense of identity? • How would life be different if there were no transformations? • What information must be given in order to define a translation? • What does a pattern look like that has been created using translations? • What is the result when a shape is translated twice? • What information must be given to describe a reflection? • How can you describe the process of reflecting an object or shape? • What shapes look the same after they have been reflected? • What is the net result when we reflect something twice across the same mirror line? • How can a rotation be described? • Draw or describe some shapes that look the same after they have been transformed. • What is the net result when you rotate something twice by two different angles?
Related Misconceptions	
<ul style="list-style-type: none"> • Transformations are used only in a mathematics classroom. • Indigenous cultures do not use transformations in their art. • Transformations describe sizes, positions, and orientations of shapes under informal transformations such as flips, turns, slides, and scaling. 	
Knowledge <i>Students will know...</i>	Skills <i>Students will be able to...</i>
<ul style="list-style-type: none"> • Transformations (translations, reflections, rotations, and dilations) are all around us. • There are different types of transformations, informally they can be referred to as: flips, turns, slides, and scaling. • Similarity, symmetry, congruency are the basis of many transformations. 	<ul style="list-style-type: none"> • Identify and classify translations, reflections, rotations, and dilations in figures and patterns. • Reproduce a given transformation on grid paper. • Make connections between mathematics and artistic endeavors of Indigenous artifacts, particularly Haida Button blankets. • Create their logo design that would include a variety of transformations. • Create their own blanket design that would include a variety of transformations.

Assessment Evidence (Stage 2)

Assessment Rubric					
Level	Problem Solving	Reasoning and Proof	Communication	Connections	Representation
Novice	<ul style="list-style-type: none"> No strategy is chosen, or a strategy is chosen that will not lead to a solution. 	<ul style="list-style-type: none"> Arguments are made with no mathematical basis. No correct reasoning nor justification for reasoning is present. 	<ul style="list-style-type: none"> No awareness of audience or purpose is communicated. Little or no communication of an approach is evident. 	<ul style="list-style-type: none"> No connections are made. 	<ul style="list-style-type: none"> No attempt is made to construct mathematical representations.
Apprentice	<ul style="list-style-type: none"> A partially correct strategy is chosen, or a correct strategy for only solving part of the task is chosen. 	<ul style="list-style-type: none"> Arguments are made with some mathematical basis. Some correct reasoning or justification for reasoning is present with trial and error, or unsystematic trying of several cases. 	<ul style="list-style-type: none"> Some awareness of audience or purpose is communicated, and may take place in the form of paraphrasing of the task. 	<ul style="list-style-type: none"> Some attempt to relate the task to other subjects or to own interests and experiences is made. 	<ul style="list-style-type: none"> An attempt is made to construct mathematical representations to record and communicate problem solving.
Practitioner	<ul style="list-style-type: none"> A correct strategy is chosen based on the mathematical situation in the task. Evidence of solidifying prior knowledge and applying it to the problem-solving situation is present. 	<ul style="list-style-type: none"> Arguments are constructed with adequate mathematical basis. A systematic approach and/or justification of correct reasoning is present. 	<ul style="list-style-type: none"> A sense of audience or purpose is communicated. Communication of an approach is evident through a methodical, organized, coherent, sequenced, and labeled response. 	<ul style="list-style-type: none"> Mathematical connections or observations are recognized. 	<ul style="list-style-type: none"> Appropriate and accurate mathematical representations are constructed and refined to solve problems or portray solutions.
Expert	<ul style="list-style-type: none"> An efficient strategy is chosen and progress toward a solution is evaluated. Adjustments in strategy, if necessary, are made along the way, and/or alternative strategies are considered. 	<ul style="list-style-type: none"> Deductive arguments are used to justify decisions and may result in more formal proofs. Evidence is used to justify and support decisions made and conclusions reached. 	<ul style="list-style-type: none"> A sense of audience and purpose is communicated. Communication at the practitioner level is achieved, and communication of arguments is supported by mathematical properties used. 	<ul style="list-style-type: none"> Mathematical connections or observations are used to extend the solution. 	<ul style="list-style-type: none"> Abstract or symbolic mathematical representations are constructed to analyze relationships, extend thinking, and clarify or interpret phenomenon.

Key Vocabulary

Transformation, Rotation, Reflection, Translation, Enlargement, Dilation, Slide, Turn, Flip, Scale, Congruency, Similarity, Symmetry, Line or symmetry, Point of Rotation, Logo, Crest, Design.

Learning Plan (Stage 3)

Unit Overview

Lesson 1: Connections and Activating Prior Knowledge

- a) The teacher introduces a variety of everyday and sports logos to show the use of transformations.
- b) The teacher introduces a variety of relevant cultural artifacts (Haida artifacts and blankets).
- c) The students use their imagination and write a story, song or poem that is central to the artifact.
- d) The students, led by example from the teacher, describe the cultural artifact in mathematical terms.

Lesson 2: Translations

- a) The students draw a triangle on graph paper to review coordinate graphing.
- b) The teacher introduces relevant terms: translation, pre-image, image, and congruent.
- c) The students, led by example from the teacher, perform translations on their graphing paper.
- d) The teacher leads a discussion on translations with the students.

Lesson 3: Reflections

- a) The students investigate what happens to objects when viewed through a mirror.
- b) The teacher introduces relevant terms: reflection and line of reflection (mirror).
- c) The students investigate reflections through Scott Kim's 'Half words.
- d) The students use miras to reflect their names on a piece of paper.
- e) The students use miras to do a reflection of Haida crests and art.
- f) The teacher leads a discussion on reflections with the students.

Lesson 4: Reflection Symmetry

- a) The teacher introduces relevant terms: reflection symmetry, line of symmetry, and symmetric.
- b) The students investigate the reflection symmetry on Haida crests and art using miras.
- c) In pairs or triples, the students investigate the lines of symmetry in various shapes using miras.
- d) The teacher leads a discussion on reflection symmetry and how it relates to reflections.

Lesson 5: Rotations

- a) The students investigate what happens to objects when they are rotated with the use of clear paper.
- b) The teacher introduces relevant terms: rotation, and rotational symmetry.
- c) The students investigate rotation on Haida artifacts using clear paper.
- d) The students draw a rotation using clear paper.

Lessons 6/7: Creating a Design or Button Blanket

- a) In the form of an assessment, the students design a transformation to be performed by another student.
- b) The students then give their transformation to another student to perform.
- c) The students investigate transformations in Haida artifacts and blankets.
- d) The students create their own blanket design that would include a variety of transformations.
- e) The students create their logo design that would include a variety of transformations.

Logos



1. _____



2. _____



3. _____



4. _____



5. _____



6. _____



7. _____



8. _____



9. _____



10. _____



11. _____



12. _____

SPORTS LOGOS



1. _____



2. _____



3. _____



4. _____



5. _____



6. _____



7. _____



8. _____



9. _____



10. _____



11. _____



12. _____

HAIDA BLANKETS



1. _____



2. _____



3. _____



4. _____



5. _____



6. _____



7. _____



8. _____



9. _____



10. _____

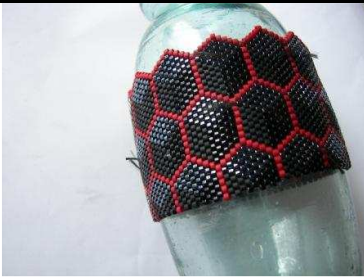


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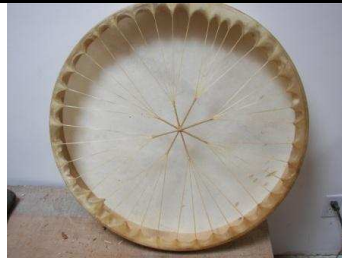


12. _____

Haida Artifacts



1. _____



2. _____



3. _____



4. _____



5. _____



6. _____



7. _____



8. _____



9. _____



10. _____



11. _____



12. _____

SCOTT KIM'S HALF WORDS

HALF WORDS

Each design on this page is really half of a word. Can you figure out what each design says? To read a design, take two copies of this page, place one copy on top of the other, and slide them around until the two copies of the design meet. Hold the papers up to a light so you can see through both sheets. You may have to rotate or flip over one of the pages. For instance, the second design makes the word "mirror".



1. T CEDOV J a C
2. M ns
3. E H T H T
4. S y m a t a

Source:
<http://www.scottkim.com/inversions/halfwords.html>

HAIDA CRESTS AND ART



1. _____



2. _____



3. _____



4. _____



5. _____



6. _____



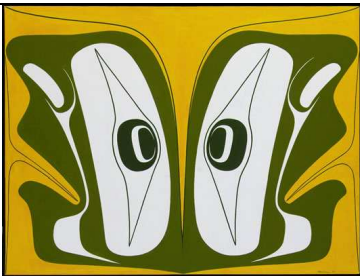
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11. _____



12. _____

TRANSFORMATIONS

A transformation is a one-to-one mapping on a set of points. The most common transformations map the points of the plane onto themselves, in a way which keeps all lengths the same.

There are four transformations in the plane: translations, rotations, reflections, and glide reflections.



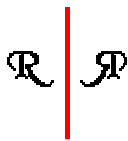
Translations

A *translation* slides all the points in the plane the same distance in the same direction. This has no effect on the sense of figures in the plane. There are no invariant points (points that map onto themselves) under a translation.



Rotations

A *rotation* turns all the points in the plane around one point, which is called the center of rotation. A rotation does not change the sense of figures in the plane. The center of rotation is the only invariant point (point that maps onto itself) under a rotation. A rotation of 180 degrees is called a *half turn*. A rotation of 90 degrees is called a *quarter turn*.



Reflections

A *reflection* flips all the points in the plane over a line, which is called the mirror. A reflection changes the sense of figures in the plane. All the points in the mirror contain all the invariant points (points that map onto themselves) under a reflection.



Glide reflections

A *glide reflection* translates the plane and then reflects it across a mirror parallel to the direction of the translations. A glide reflection changes the sense of figures in the plane. There are no invariant points (points that map onto themselves) under a glide reflection.

Source: <http://plato.acadiau.ca/courses/educ/reid/Geometry/Symmetry>