

Rurality, Reconciliation and Arithmetic in the Middle Years:
Understanding Indigenous Tessellation Artwork

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03.366: Evaluation and Assessment
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3 March 2025

Objective:

Make a series of lessons that draws on indigenous ways of knowing, doing and being. Using Tessellations and comparing it to Indigenous artwork. This will be split into three consecutive lesson plans (60 minutes each).

Learning Outcomes:

8.SS.6 Demonstrate an understanding of tessellations by explaining the properties of shapes that make tessellating possible creating tessellations identifying tessellations in the environment [C, CN, PS, T, V]

Enduring Understandings: Many geometric properties and attributes of shapes are related to measurement. Tessellations are created using transformations.

General Learning Outcome: Describe and analyze position and motion of objects and shapes.

Building Student Understanding:

- A range of materials and methods of traditional and contemporary artistic practices to plan personal works of art and design
- Cultural and Historical Perspectives
- Relate artistic ideas and works with societal, cultural, and historical context to deepen understanding.
- Analyze works of art in a variety of societal, cultural, and historical contexts and make connections to uses of art in contemporary and local contexts.

Overview:

The teacher will use the following powerpoint 'Diamonds, Not Just a Girl's Best Friend,' to explore Escher-like drawings and Indigenous tessellation artwork. Students will discuss the principles of design in the drawings and applications to the Manitoba curriculum document. Students will discuss Escher artwork and then discuss similarities of Indigenous artwork that preceded Escher using a Venn diagram. Students will reflect on the idea of multiple discovery and discuss why the Indigenous and Escher arrived at similar ideas with different applications.

5 E method:

Engage - students will start the lessons by giving feedback based on what they know about tessellations, if they can relate these to any types of artworks/artists.

Explore - Students spend time looking at artwork of Escher and Indigenous artwork. Once they have established some understanding of tessellation artwork, they will begin a discussion period where they explain what they had observed for the shape and space of the artwork.

Explain - Students will watch videos of Escher's artwork and Indigenous artwork. Students will create their own tessellation artwork after gaining inspiration from both sources. Students will write in their KWL charts what they have observed and learned.

Elaborate - Students will explain how either Escher or Indigenous artwork was used as inspiration to define the type of tessellation they have created. Students will demonstrate to peers and the teacher their tessellation mathematics and design.

Evaluate - Students self reflect and peer reflect on their tessellation artwork creations. Students will engage in a presentation and gallery walk to bolster their understanding of tessellations. The teacher will evaluate whether they have fully understood and grasped the core concepts of tessellations.

Tessellations:

Three regular polygons—equilateral triangles, squares, and hexagons—will tessellate the plane because their angles are a factor of 360° . Irregular polygons whose angles add to a factor of 360° will also tessellate the plane. Polygons that tessellate the plane can be used to make tessellations (Manitoba curriculum, 2025).

This includes numbers such as 30, 45, 60, 90, 120, 135, 180, 360 degrees.

Extension Opportunity:

Students may make a star quilt that can be used as a symbolic gift to local elders/community from the classroom activity. Star quilts have a long history of being given as gifts to honor people and events. This can be a great opportunity to have an elder come give a talk within a lesson and a return of service through giving them back a star quilt made by the class. Images of a star quilt are provided at the Brandon University Education building.

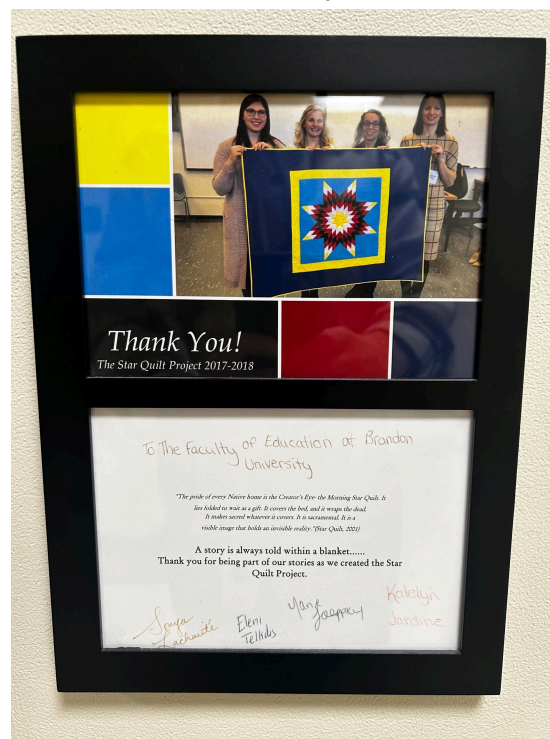


Figure 1: Star quilt thank you plaque.



Figure 2: Star quilt made by Brandon University Education students.

Lesson Plan

Grade/Class	Grade 8 Mathematics	Date/Time	Class 1
Topic/Unit Title	Introduction to Tessellations	Time	0-60 mins

Lesson Outcomes / Purpose

Curriculum: Outcomes, Essential Questions, Targeted Learning and Experiences

Utilizing Manitoba curricula list all outcomes, essential questions, descriptions of targeted learning or experiences that will be presented/explored in this lesson.

8.SS.6 Demonstrate an understanding of tessellations by explaining the properties of shapes that make tessellating possible creating tessellations identifying tessellations in the environment [C, CN, PS, T, V]

Specific Learning Outcomes and Evidence of Learning

Expand on the targeted learning and curricular outcomes noted above. Consider referring to the supplemental resource attached to the Unit Planning Template, "*Appendices of Verbs*" and making use of sentence leads, ("The student(s) will be able..."(TSWBA) and "I

can..." statements) to describe what observable evidence of learning students will engage in, and on which they may be assessed. For example:

1. Students will categorize... (Cognitive Domain, Analyze)
2. Students will design...(Affective Domain)
3. I can draw and label the parts of a tree. (Cognitive & Psychomotor Domain, Remember & Simple)
4. I can create coding to move my sphero to a 3 – 4 beat (Psychomotor Domain, Complex)

Learning outcomes:

- Students will understand and explain the properties of shapes that allow tessellation
- Students will identify tessellations in various artworks

Evidence:

- The formative feedback from the students will indicate whether they have grasped the material presented. This is done by the KWL chart, class discussion.

Cross-Curricular/Real World Connections

Note any relevant cross-curricular outcomes, essential questions or experiences or authentic learning present in this lesson.

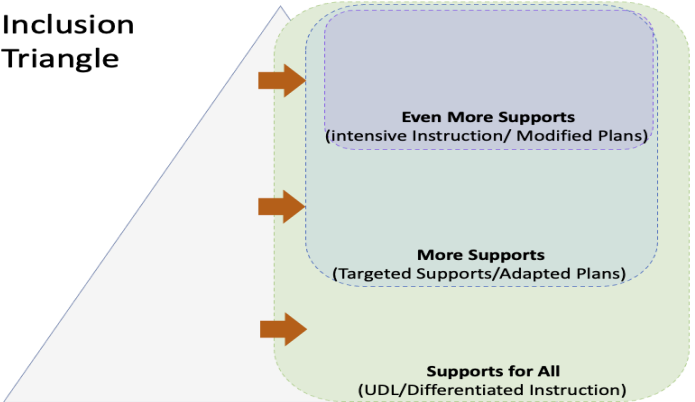
- Connection between mathematics and artwork.
- Cultural Understanding of artwork: Tessellation application in different contexts, such as indigenous artwork.

Assessment Evidence

Description (conversation, observation or product)	FOR	AS	OF
KWL chart	x	x	
professional quilter Crystal Pewo Lightfoot video	x		
Student discussion period	x	x	
Student-teacher discussion period	x	x	

Materials (ICT considered)

Differentiated Instruction & Student Specific Planning

<p>Resources (referenced), handouts, ICT, equipment, etc. Include exemplars / samples</p> <ul style="list-style-type: none"> - Lesson slides - Smartboard - KWL chart - videos <p>Key Words / Vocabulary</p> <ul style="list-style-type: none"> - Tessellations - Factors - Lightfoot - Star quilt - 	<p>Inclusion Triangle</p>  <p>Adapted from Shelley Moore, 2015</p> <p>Considering students' readiness, interests, and learning profile, how will learning tasks for this lesson be differentiated?</p> <ul style="list-style-type: none"> - Closed captions can be added to the videos for those with auditory impairments. - Students can be paired in larger groups based on needed accommodations
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Learning Plan		
<p>Hook Activate</p>	<p>The teacher will hand out a KWL chart to identify students' knowledge of tessellations and indigenous artwork.</p> <p>Students will be introduced to a professional quilter Crystal Pewo Lightfoot, who will talk about the making of traditional plains-tribe star quilts, and how color and other principles of design play a role in design. https://youtu.be/a38fjNw6-Oc</p>	<p>Time 5 minutes</p> <p>15 minutes</p>
<p>Acquire</p>	<p>After playing the video for the students, they will be able to identify things that they have learned from the video. They should write down what they have learned from the video within this allotment of time. Students should give visual queues as to whether they have written down everything that they have needed. Students will be asked: How do patterns and designs play into tessellations?</p>	<p>5 minutes</p>

beyond the classroom. Students will identify patterns and relationships between tessellation. The first lesson uses formative assessment to gauge students' understanding throughout. Students are given multiple chances to reflect on tessellations and their knowledge. This allows them to strengthen their understanding before being given the chance to create their own tessellation artwork. By integrating cultural relevance into the lesson plan, students are enriched by indigenous culture.

Lesson Plan

Grade/Class	Grade 8 Mathematics	Date/Time	Class 2
Topic/Unit Title	Creation of Tessellations	Time	61-120 mins

Lesson Outcomes / Purpose

Curriculum: Outcomes, Essential Questions, Targeted Learning and Experiences

Utilizing Manitoba curricula list all outcomes, essential questions, descriptions of targeted learning or experiences that will be presented/explored in this lesson.

8.SS.6 Demonstrate an understanding of tessellations by explaining the properties of shapes that make tessellating possible creating tessellations identifying tessellations in the environment [C, CN, PS, T, V]

Specific Learning Outcomes and Evidence of Learning

Expand on the targeted learning and curricular outcomes noted above. Consider referring to the supplemental resource attached to the Unit Planning Template, “*Appendices of Verbs*” and making use of sentence leads, (“The student(s) will be able...”(TSWBA) and “I can...” statements) to describe what observable evidence of learning students will engage in, and on which they may be assessed. For example:

1. Students will categorize... (Cognitive Domain, Analyze)
2. Students will design...(Affective Domain)
3. I can draw and label the parts of a tree. (Cognitive & Psychomotor Domain, Remember & Simple)
4. I can create coding to move my sphero to a 3 – 4 beat (Psychomotor Domain, Complex)

Learning outcomes:

- Students will understand and explain the properties of shapes that allow tessellation
- Students will identify tessellations in various artworks

Evidence:

- The formative feedback from the students will indicate whether they have grasped the material presented. This is done by class discussion.
- Students will make their own tessellation artwork, identify whether the pieces satisfy the requirements of tessellations.

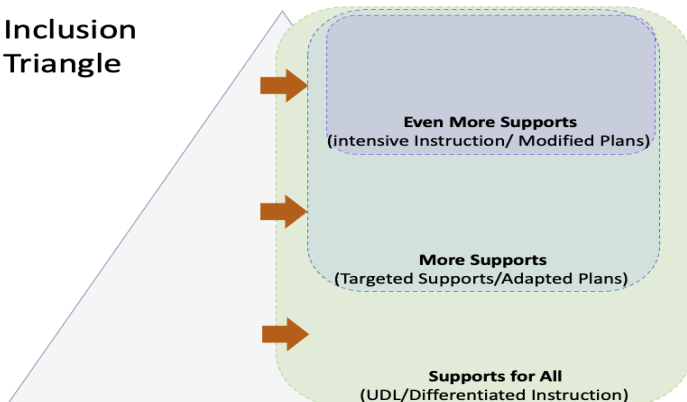
Cross-Curricular/Real World Connections

Note any relevant cross-curricular outcomes, essential questions or experiences or authentic learning present in this lesson.

- Connection between mathematics and artwork.
- Cultural Understanding of artwork: Tessellation application in different contexts, such as indigenous artwork.

Assessment Evidence

Description (conversation, observation or product)	FOR	AS	OF
Escher Videos	x	x	
Tessellation revisitation	x		
Indigenous start quilts video	x	x	

Creating Tessellation artwork		X	X
Materials (ICT considered)		Differentiated Instruction & Student Specific Planning	
<p>Resources (referenced), handouts, ICT, equipment, etc. Include exemplars / samples</p> <ul style="list-style-type: none">- Paper- Pencils- Colored mediums (color in)- Artwork printout <div>Key Words / Vocabulary</div> <ul style="list-style-type: none">- Tessellations- Escher- Lightfoot- Balance- Focal point- pattern- Rhythm		<div><div>Inclusion Triangle</div><p>Adapted from Shelley Moore, 2015</p><p>Considering students’ readiness, interests, and learning profile, how will learning tasks for this lesson be differentiated?</p><ul style="list-style-type: none">- Closed caption will be on for videos while they play in the background- Precut patterns can be used to assist with students drawing/making tessellation shapes</div>	
Learning Plan			
Hook Activate	<p>Students will be introduced into tessellations using Escher videos to support their understanding of tessellations.</p> <p>https://youtu.be/Kcc56fRtrKU</p>		<p>Time</p> <p>10 minutes</p>

Rationale:

The second lesson focuses on exploring and creating tessellations using inspiration drawn from this and the previous lesson. Students apply their knowledge of tessellations by creating tessellations designs. This lesson reinforces the concepts of tessellations by building physical connections between theory and practice. By using additional videos of Escher and Indigenous artworks, students are able to visualize real world applications of tessellations. Videos act as a support during the creation process to stimulate new ideas and help students refine their own work. Sharing their tessellation artwork and ideas with peers gives students a chance to reflect on their own and others' artwork to develop a stronger understanding of tessellations.

Lesson Plan

Grade/Class	Grade 8 Mathematics	Date/Time	Class 3
Topic/Unit Title	Discussion of Tessellations	Time	121-180 mins

Lesson Outcomes / Purpose

Curriculum: Outcomes, Essential Questions, Targeted Learning and Experiences

Utilizing Manitoba curricula list all outcomes, essential questions, descriptions of targeted learning or experiences that will be presented/explored in this lesson.

8.SS.6 Demonstrate an understanding of tessellations by explaining the properties of shapes that make tessellating possible creating tessellations identifying tessellations in the environment [C, CN, PS, T, V]

Specific Learning Outcomes and Evidence of Learning

Expand on the targeted learning and curricular outcomes noted above. Consider referring to the supplemental resource attached to the Unit Planning Template, “*Appendices of Verbs*” and making use of sentence leads, (“The student(s) will be able...”(TSWBA) and “I can...” statements) to describe what observable evidence of learning students will engage in, and on which they may be assessed. For example:

1. Students will categorize... (Cognitive Domain, Analyze)
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4. I can create coding to move my sphero to a 3 – 4 beat (Psychomotor Domain, Complex)

Learning outcomes:

- Students will understand and explain the properties of shapes that allow tessellation
- Students will identify tessellations in various artworks

Evidence:

- The formative feedback from the students will indicate whether they have grasped the material presented. This is done by class discussion.
- Students will make their own tessellation artwork, identify whether the pieces satisfy the requirements of tessellations.
- Students will be able to explain their reasoning behind choosing certain patterns within their tessellation artwork

Cross-Curricular/Real World Connections

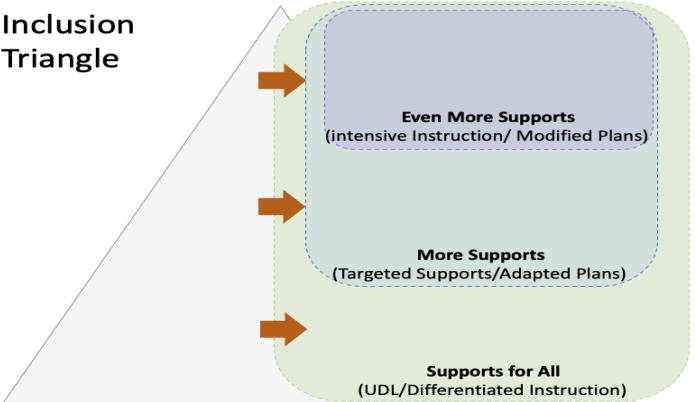
Note any relevant cross-curricular outcomes, essential questions or experiences or authentic learning present in this lesson.

- Connection between mathematics and artwork.
- Cultural Understanding of artwork: Tessellation application in different contexts, such as indigenous artwork.

Assessment Evidence

Description (conversation, observation or product)	FOR	AS	OF
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Creating Tessellation artwork		X	X
Tessellation presentations		X	X
Self and peer feedback of artwork		X	X

Materials (ICT considered)	Differentiated Instruction & Student Specific Planning
<p>Resources (referenced), handouts, ICT, equipment, etc. Include exemplars / samples</p> <ul style="list-style-type: none"> - Venn diagrams - Tessellation artwork - Stapler - <p>Key Words / Vocabulary</p> <ul style="list-style-type: none"> - Tessellations - Escher - Factors - Lightfoot 	<p>Inclusion Triangle</p>  <p>Adapted from Shelley Moore, 2015</p> <p>Considering students' readiness, interests, and learning profile, how will learning tasks for this lesson be differentiated?</p> <ul style="list-style-type: none"> - Presentation may be done in front of the class or in private depending on comfort level of students - Artwork may be chosen not to put on the wall if specified

Learning Plan		
Hook Activate	<p>The teacher will prompt the students whether they have met all of the content requirements for the tessellation product.</p> <p>The teacher will say that students will have a period of time before their presentations.</p>	<p>Time</p> <p>5 minutes</p>

Acquire	Students will have time to wrap up anything left with their tessellation artwork. This will allow students to get a short grasp of everything they have created in the previous day's time.	15 minutes
Apply	Students will present and give feedback to themselves and to their peers about their tessellation artwork. Students will submit their work following for assessment.	35 minutes
Closure	Students will help put the artwork up within the classroom. Students will have time to have a gallery walk around the classroom to look at all of the peer artwork created during this lesson project.	5 minutes
Reflections about the lesson:		

Rationale:

The final lesson provides students an opportunity to reflect, discuss, and present their artwork. By presenting their tessellation artwork and explaining their design and pattern relationship, students develop a deeper understanding of the mathematics behind tessellations. This lesson contains self and peer feedback through both a presentation and a gallery walk, allowing students to explore various tessellations designs. Additionally, students feel more motivated throughout the three lessons by creating tessellation artwork that will be put up within the classroom. By creating tessellation artwork, we can achieve formative and summative assessment.

Tessellation Artwork Rubric:

Criteria	Excellent (4)	Good (3)	Satisfactory (2)	Needs Improvement (1)	Zero (0)
Creativity & Originality	The artwork features highly unique, innovative patterns and shapes, clearly showcasing the artist's personal creativity and an imaginative approach to tessellation.	The artwork is original but includes some predictable patterns or shapes that reduce its uniqueness.	The artwork contains mostly standard or repeated patterns with minimal variations in design.	The artwork lacks originality, uninspired patterns, resulting in a less creative design.	No creative effort was made; the artwork is a direct copy or unfinished.
Understanding of Tessellation	The artwork flawlessly demonstrates tessellation principles (shape repetition, no gaps, no overlaps), with perfectly fitting shapes throughout.	The artwork shows a solid understanding of tessellation, with minor gaps or overlaps that do not detract significantly from the overall design.	The artwork shows an attempt at tessellation but has noticeable gaps or overlaps in some areas, affecting the design's flow.	The artwork demonstrates minimal understanding of tessellation, with significant gaps or overlaps throughout.	The artwork does not use tessellation principles, with shapes not fitting together at all.
Use of Shape and Space	The shapes are expertly chosen to tessellate, and their arrangement is visually dynamic and thoughtfully planned, creating a balanced, appealing design.	The shapes chosen generally tessellate well, with a layout that is mostly balanced, though some areas could be arranged more cohesively.	The shapes used tessellate somewhat but could be arranged more effectively. Some areas feel disconnected or uneven in the overall layout.	The shapes do not tessellate well, with irregular or poorly planned arrangements that disrupt the flow of the pattern.	The shapes do not tessellate, and the arrangement appears disorganized or random, leading to a chaotic visual result.

Presentation & Effort	The artwork is neat, with precise lines, smooth transitions, and a high level of effort that reflects attention to detail throughout.	The artwork is neatly presented with attention to detail, though some small areas could be refined for consistency.	The artwork shows effort but lacks precision in some areas, with visible flaws or rough spots that affect its overall appearance.	The artwork is poorly presented, with a noticeable lack of attention to detail and effort, including smudges or unrefined edges.	The artwork is incomplete or presented in a form that cannot be easily understood due to minimal effort.
Reflection & Explanation	The student provides a comprehensive and thoughtful explanation, clearly articulating their reasoning behind design choices, demonstrating a deep understanding of tessellation principles and process.	The student provides a clear explanation of design choices, showing a good understanding of tessellation, but may lack depth in some areas.	The student offers a basic explanation, providing some insight into the choices made, though it is limited in detail or depth.	The student provides an explanation that lacks clarity, leaving significant gaps in understanding or reasoning.	No explanation is provided, or the explanation is completely irrelevant to the artwork.

Bibliography:

ChatGPT - Rubric table information

<https://chatgpt.com/>

Comparing the Quilts of Indigenous Plains People with the Tessellations of M.C. Escher, Part 1: Diamonds, Not Just a Girl's Best Friend

[James Doyle](#), [Lindsey Link](#), [Michell Eike](#) | *Published: August 15th, 2023 by K20 Center*

<https://learn.k20center.ou.edu/lesson/2936>

Comparing the Quilts of Indigenous Plains People with the Tessellations of M.C. Escher, Part 2: Escher's Terrific Tessellations: The Art of Tile Transformations

[James Doyle](#), [Lindsey Link](#) | *Published: August 15th, 2023 by K20 Center*

<https://learn.k20center.ou.edu/lesson/3106>

Escher's Terrific Tessellations: The Art of Tile Transformation (2024) - youtube

<https://youtu.be/mnsHvHgSpE8>

K20 ICAP - Quilter - Diamonds, Not Just A Girl's Best Friend

<https://www.youtube.com/watch?v=a38fjNw6-Oc>

Manitoba Curriculum Grade 8:

https://www.edu.gov.mb.ca/k12/cur/math/support_gr8/full_doc.pdf

Star Quilt Project for "Diamonds, Not Just A Girl's Best Friend

<https://www.youtube.com/watch?v=HBE10iBWgQ0>

The Mathematical Art of M.C. Escher (2010) - youtube

<https://youtu.be/Kcc56fRtrKU>