LESSON TITLE: TESSELLATIONS

TOTAL TIME: ONE 60-MINUTE PERIOD

BRIEF DESCRIPTION

In this *The House That STEM Built* lesson plan, students will have the opportunity to explore regular and semi-regular tessellations. This lesson plan will cover what tessellations are, where you might find them, and how calculating internal angles helps determine whether a shape can be tessellated. Students will be introduced to tessellations with a “Notice and Wonder” activity before watching *The House That STEM Built: Tessellations* video. Students will then try their hand at creating their own semi-regular tessellations which they will demonstrate in a class gallery walk.

CURRICULUM OUTCOMES

Taken from the New Brunswick Grade 12 Financial and Workplace Math curriculum.

GENERAL CURRICULUM OUTCOMES

GCO Geometry (G): Develop spatial sense.

SPECIFIC CURRICULUM OUTCOMES

SCO G3: Demonstrate an understanding of transformations of a 2-D shape or a 3-D object, including translations, rotations, reflections, and dilations.

NEW BRUNSWICK GLOBAL COMPETENCIES ACHIEVED[1]

- Critical Thinking and Problem-Solving
    - Learners engage in an inquiry process to solve problems, as well as acquire, process, interpret, synthesize, and critically analyze information to make informed decisions.
    - Learners construct, relate and apply knowledge to all domains of life, such as school, home, work, friends, and community.
    - Learners formulate and express questions to further their understanding, thinking, and problem-solving.
- Collaboration
    - Learners learn from and contribute to the learning of others by co-constructing knowledge, meaning, and content.
- Communication
    - Learners ask effective questions to create a shared communication culture, attend to understand all points of view, express their own opinions, and advocate for ideas.

LEARNING OBJECTIVES

Learners will

- identify regular and semi-regular tessellations,
- calculate interior angles, and
- create unique tessellations.

---

1 https://www2.gnb.ca/content/dam/gnb/Departments/ed/pdf/K12/curric/competencies/NBCompetencies.pdf?fbclid=IwAR1ldrZs1gFgiNm8rC4oz7Fmx6mSn-6t_QJkenev0eD33rZ-foYYn6bmdmc also available at https://tinyurl.com/nb-competencies

MATERIALS

- Video: *The House That STEM Built: Tessellations*.
- “Notice and Wonder” (to be projected).
- “Tessellation Designer” handout (1 per person).
- White paper (optional).
- Colouring utensils (optional).
- Rulers (optional).
- Access to technology (optional).

MINDS ON: 5 MINUTES

GROUPING: ENTIRE CLASS

Project the “Notice and Wonder” picture onto the board or choose a similar tessellated image online.

Ask students to take a moment and look at the image projected. What is it? Have they seen something similar? Where did they see it? What do they notice about the picture? Are there any other questions they have about it?

Take a couple of comments or questions from the class before moving on to *The House That STEM Built: Tessellations* video.

ACTIVITY: 20 MINUTES

GROUPING: ENTIRE CLASS

Watch *The House That STEM Built: Tessellations* video. Included in this video are some opportunities to stop and discuss the topic as well as try some examples. Feel free to pause the video and ask some or all of the following questions to prompt conversation.

→ 1:02 – Before we get truly started, has anyone heard the term tessellation before? Does anything come to mind?

→ 1:14 – Can anyone think of a good example of a tessellation that they have seen in their everyday life before?

→ 2:16 – As the video mentioned, for us to determine whether or not a shape can be tessellated, we need to know what the interior angles of the shape are. Can anyone remember how we figure out the interior angles of a shape?

→ 2:25 – Let's break it down. What do all of the interior angles of a triangle add up to?

→ 3:31 – Let's practice this equation with a couple of examples. What are the interior angles of the following shapes? Keep in mind that n = the number of sides on the shape.

Each interior angle of a regular polygon

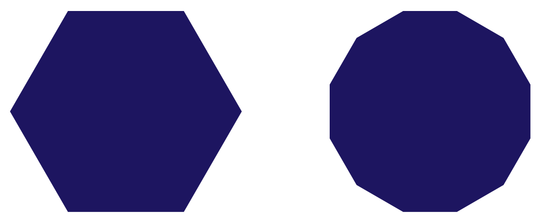
$$= (n - 2) \times \frac{180°}{n}$$

Hexagon:

$$(6 - 2) \times \frac{180°}{6} = 120°$$

Dodecagon:

$$(12 - 2) \times \frac{180°}{12} = 120°$$



→ 3:52 – For a shape to tessellate, it needs to be able to rotate around a vertex (fixed point) and leave no space or gaps. If we take a look at the interior angles of the triangles that are touching the vertex, how many degrees do you think the angles will add up to? How do we know this?

→ 4:30 – If we take a look back at the last two examples we did with the hexagon and dodecagon (12-sided polygon), can you tessellate either of these shapes? How do we know this?

→ 4:49 – Let's think back to the example we did together with the hexagon and the dodecagon. Could our earlier examples be used in a regular tessellation (a tessellation that only includes one shape) or a semi-regular tessellation (a tessellation that includes more than one shape)?

→ 6:40 – Are there any other examples of tessellations in your house that you can think of?

→ 7:56 – Is it possible to use our dodecagon example in a tessellation? What would we have to do to make that possible?

→ 8:11 – How could tessellations reduce waste and lower labour costs?

ACTIVITY: 20 MINUTES

GROUPING: INDIVIDUAL

Hand out a copy of the “Tessellation Designer” handout. Ask students to start by filling in the table provided. The table includes many different shapes and the goal is for students to calculate the internal angle of each of the shapes.

Once they have calculated all of the internal angles, ask the students to choose at least 3 shapes to create a semi-regular tessellation. This can be done by hand on paper with rulers and colouring utensils or it can be done using an online tool such as https://app.diagrams.net/ or https://www.nctm.org/Classroom-Resources/Illuminations/Interactives/Tessellation-Creator/ *also available at* https://tinyurl.com/tessellation-creator. Students should create a tessellation that includes at least 20 shapes if done physically on paper, and 30 if done digitally.

ACTIVITY: 10 MINUTES

GROUPING: ENTIRE CLASS

Once students finish up their tessellation design, you can host a brief gallery tour, where students get the chance to take a look at everyone else’s tessellation end products, and students can explain why they chose the shapes they did, and what interior angles were used.

CONCLUSION: 5 MINUTES

GROUPING: INDIVIDUAL

As an exit slip, ask students to jot down 3 key things that they need to keep in mind if they want to create a regular or semi-regular tessellation.

DIFFERENTIATION

CONTENT

Do your students take an art class? Are there any opportunities for a cross-subject project? Create a tessellated garden stone or wall mandala.

Have students research the history of tessellations and the math behind them. Where did they originate? What was their purpose? What did they look like? Dive into this topic with a podcast or short video.

Are there any local experts that would be willing to talk to your class about their job? Ask them to stop in.

PRACTICE

Are there any tessellations around your school? What shapes are involved? What are the internal angles?

Do you have an art gallery nearby? If not, check online for some modern art with different examples of tessellations. Are they regular tessellations or semi-regular tessellations? Which shapes were used? Which internal angles do the shapes have?

Take a look at a soccer ball. What is it made up of? Is this a tessellation? Could you make the same shape if you used triangles? Is it possible? What about other shapes?

Allow students to use protractors to calculate the internal angles of shapes if required.

PRODUCT

Doodle notes are a great way for students to take valuable class notes that allow them to use illustrations, colours, and creativity. Check out https://www.doodlenotes.org/ for tutorials and examples. Ask students to create some doodle notes about tessellations and calculating internal angles. They must clearly explain how to calculate them and provide examples of tessellations.

Instead of using a tessellated backsplash in your kitchen, what other options are out there? Are they more or less financially reasonable? What sort of materials are typically used? Do an investigation into tessellations in the home and present your findings in a video or presentation.

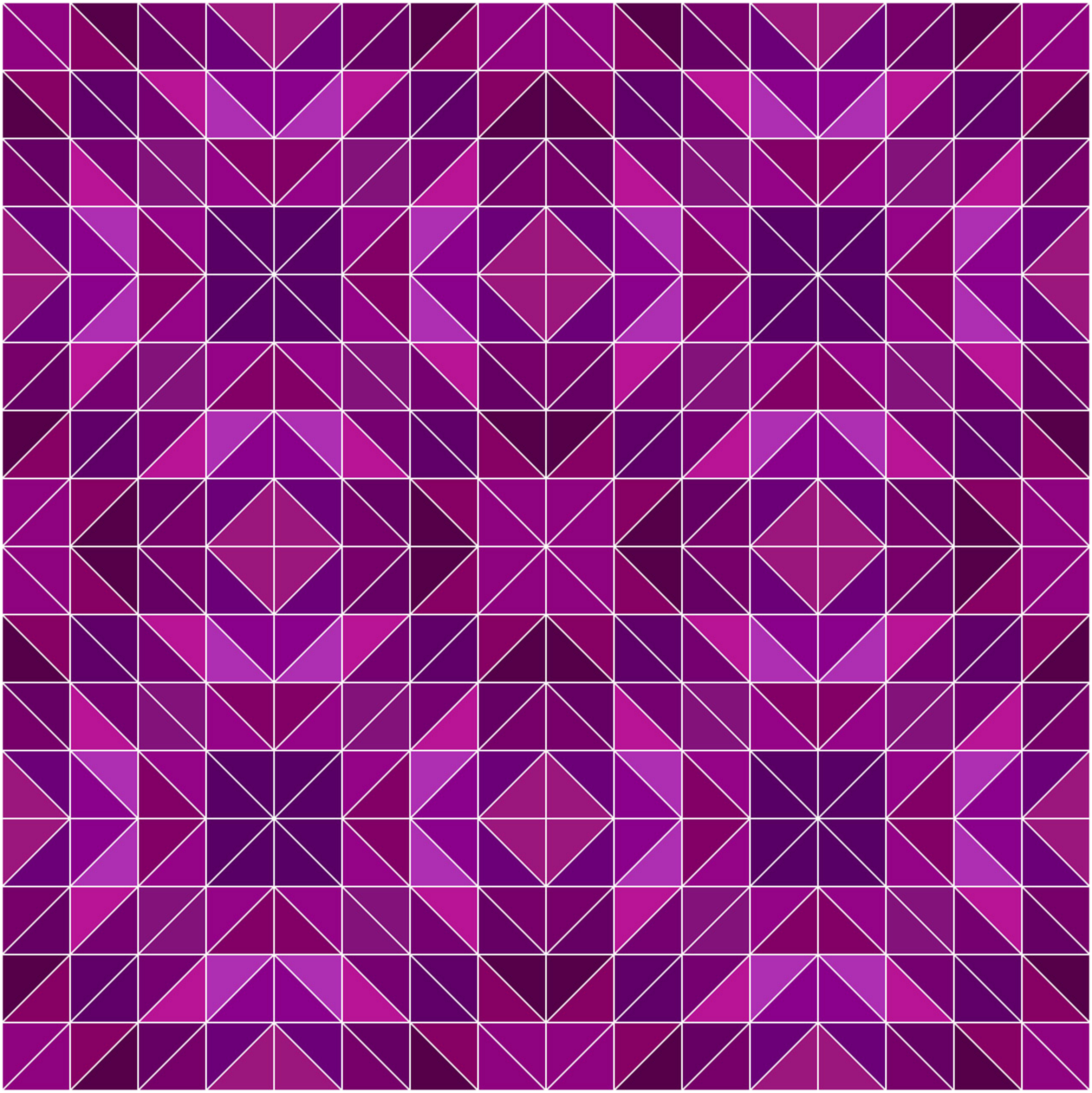
Tessellations can play a big role in video games. Investigate how they are used in games and create a simple game yourself employing tessellations using software such as https://scratch.mit.edu/ (previous coding knowledge is useful but not necessary).

EXTENSION

Tessellations often employ rotations, translations, and reflections. Take a look at some examples of tessellations and ask students to identify if there are any rotations, translations, or reflections involved.

Ask students to check out the tessellations in their homes. How many can they find? Are there any areas that could benefit from a tessellation if they were to do a renovation?

NOTICE AND WONDER



TESSELLATIONS DESIGNER

Welcome to the tessellation designer activity, where it is your task to create a unique semi-regular tessellation. To start, fill out the following table. Use the space below to show your work. Once you have all of your internal angles calculated, choose at least 3 different shapes to create your very own tessellation. Remember, to calculate the internal angles of a regular polygon, the equation is below, with n being the number of sides in the shape.

Each interior angle of a regular polygon

$$= (n - 2) \times \frac{180°}{n}$$

SHAPE	NUMBER OF INTERNAL ANGLES	VALUE OF INTERNAL ANGLES
Triangle	3	60°
Square		____°
Pentagon		____°
Hexagon		____°
Heptagon		____°
Octagon		____°
Decagon		____°
Dodecagon		____°