Task

***MathLinks 8*, page 472**

Suggested Timing
100–120 minutes

Materials
- shape to tessellate
- ruler
- coloured pencils (blue, orange, green)
- modelling clay or bingo chips

Blackline Masters
Master 1 Project Rubric
Master 9 0.5 Centimetre Grid Paper
BLM 12–23 Shape to Tessellate

Mathematical Processes
- ☑ Communication (C)
- ☑ Connections (CN)
- ☑ Mental Mathematics and Estimation (ME)
- ☑ Problem Solving (PS)
- ☑ Reasoning (R)
- ☐ Technology (T)
- ☑ Visualization (V)

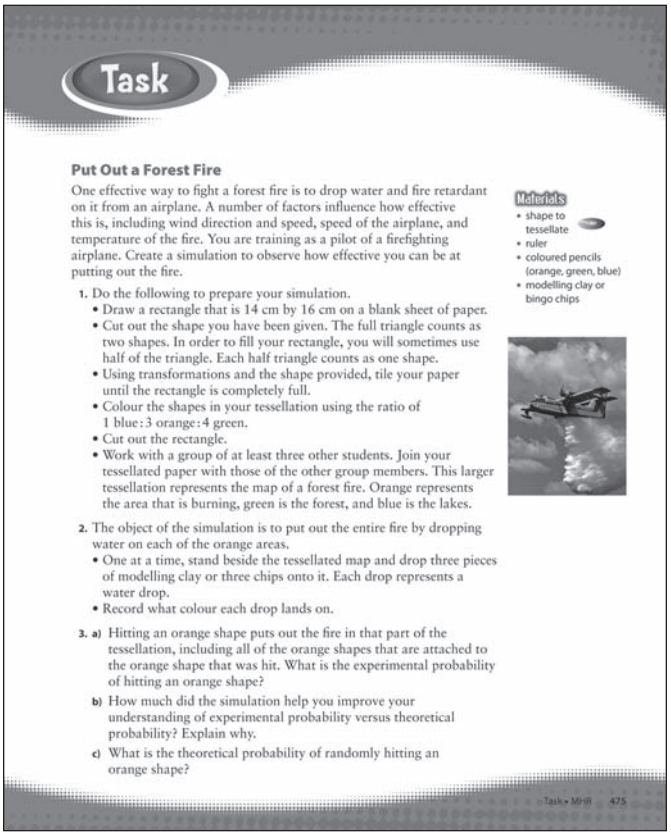
Specific Outcomes
N4 Demonstrate an understanding of ratio and rate
N5 Solve problems that involve rates, ratios and proportional reasoning.
SS6 Demonstrate an understanding of tessellations by:
- explaining the properties of shapes that make tessellating possible
- creating tessellations
- identifying tessellations in the environment.

SP2 Solve problems involving the probability of independent events.

Planning Notes

You may wish to use the following steps to introduce and complete this task:

1. Ask students to brainstorm as many patterns as they can think of that a forest fire may take and some of the factors that might affect the burn. If the following points do not come up, introduce them:
   - A fire may burn a complete section, including everything in its path.
   - A fire may burn in spots, jumping and missing other areas.
   - A burn may be affected by terrain—higher altitudes have less vegetation, and in those areas the fire might burn itself out.
   - Wind, denseness of the forest, temperature, and dryness may affect the fire.



Task

Put Out a Forest Fire

One effective way to fight a forest fire is to drop water and fire retardant on it from an airplane. A number of factors influence how effective this is, including wind direction and speed, speed of the airplane, and temperature of the fire. You are training as a pilot of a firefighting airplane. Create a simulation to observe how effective you can be at putting out the fire.

Materials
- shape to tessellate
- ruler
- coloured pencils (orange, green, blue)
- modelling clay or bingo chips

1. Do the following to prepare your simulation.
   - Draw a rectangle that is 14 cm by 16 cm on a blank sheet of paper.
   - Cut out the shape you have been given. The full triangle counts as two shapes. In order to fill your rectangle, you will sometimes use half of the triangle. Each half triangle counts as one shape.
   - Using transformations and the shape provided, tile your paper until the rectangle is completely full.
   - Colour the shapes in your tessellation using the ratio of 1 blue : 3 orange : 4 green.
   - Cut out the rectangle.
   - Work with a group of at least three other students. Join your tessellated paper with those of the other group members. This larger tessellation represents the map of a forest fire. Orange represents the area that is burning, green is the forest, and blue is the lakes.
2. The object of the simulation is to put out the entire fire by dropping water on each of the orange areas.
   - One at a time, stand beside the tessellated map and drop three pieces of modelling clay or three chips onto it. Each drop represents a water drop.
   - Record what colour each drop lands on.
3. a) Hitting an orange shape puts out the fire in that part of the tessellation, including all of the orange shapes that are attached to the orange shape that was hit. What is the experimental probability of hitting an orange shape?
   b) How much did the simulation help you improve your understanding of experimental probability versus theoretical probability? Explain why.
   c) What is the theoretical probability of randomly hitting an orange shape?

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2. As a group, discuss ways in which firefighters attempt to gain control of forest fires:
   - Ground crews dig trenches and clear underbrush.
   - Ground crews light back burns; if this new fire burns toward the existing fire and burns the vegetation in front of it, the original fire may go out when the two fires join.
   - Equipment is brought in to bulldoze trees and create nonflammable barriers.
   - Crews clear-cut ahead of the fire to limit the area burned.
   - Specially designed airplanes drop water onto the fire.
3. Provide students with **BLM 12-23 Shape to Tessellate**. Encourage students to colour their tessellation according to how they believe a forest fire might look.
4. Have students work in groups of four, six, or eight. For #2, students could use a tally chart to record the colour that each drop lands on.
5. Clarify that the task is to
   - create a simulation to observe the effectiveness of putting out a fire with water drops

- create a tessellation of a shape within a given region
- colour the tessellation in a ratio of 1 : 3 : 4
- in groups, record the results of a simulated water drop
- calculate experimental and theoretical probability of hitting the fire
- explain their understanding of experimental probability and theoretical probability

6. Review the **Master 1 Project Rubric** with students so that they will know what is expected.

Meeting Student Needs

- Students may benefit from using **Master 9 0.5 Centimetre Grid Paper**.
- Encourage students to create a tally sheet for the results of the water drop.
- The location of the group's paper for the simulation could include a bulletin board, a floor, or any available area in the room that is large enough to hold the group's map.

ELL

- Ensure that students understand the following terms: *effective*, *forest*, *wind direction and speed*, *firefighting airplane*, *simulation*, *landing water*, and *modelling clay*.

Answers

Put Out a Forest Fire

The size of the rectangle provided would give 56 of the half triangles. Seven should be coloured blue, 21 orange, and 28 green. Theoretical probability for one sheet:

Blue: $\frac{7}{56}$ or $\frac{1}{8}$; Orange: $\frac{21}{56}$ or $\frac{3}{8}$; Green: $\frac{28}{56}$ or $\frac{4}{8}$ or $\frac{1}{2}$

Experimental results will vary.

Assessment	Supporting Learning
Assessment *of* Learning	
Put Out a Forest Fire Introduce the task to the class. Have students work independently to create their tessellation, then in groups of four, six, or eight to complete the task.	• **Master 1 Project Rubric** provides a holistic descriptor that will assist you in assessing student work on this task. Page 639 provides notes on how to use this rubric for this task. • To view student exemplars, go to www.mathlinks8.ca, access the online Teacher Centre, go to Assessment, and then follow the links. • For a second task, complete with teaching notes and student exemplars, go to www.mathlinks8.ca, access the online Teacher Centre, go to Assessment, and then follow the links.

The chart below shows the **Master 1 Project Rubric** for tasks such as this one and provides notes that specify how to identify the level of specific answers for this project.

Score/Level	Holistic Descriptor	Specific Question Notes
5 (Standard of Excellence)	❑ Applies/develops **thorough** strategies and mathematical processes making **significant** comparisons/connections that demonstrate a **comprehensive** understanding of how to develop a complete solution ❑ Procedures are **efficient and effective** and may contain a **minor mathematical error** that does not affect understanding ❑ Uses **significant** mathematical language to explain their understanding and provides **in-depth** support for their conclusion	• provides a complete and correct solution
4 (Above Acceptable)	❑ Applies/develops **thorough** strategies and mathematical processes for making **reasonable** comparisons/connections that demonstrate a **clear** understanding ❑ Procedures are **reasonable** and may contain a **minor mathematical error** that may hinder the understanding in one part of a complete solution ❑ Uses **appropriate** mathematical language to explain their understanding and provides **clear** support for their conclusion	• provides a complete response, with minor calculation errors *or* • provides a complete response, with weak communication in #3b) *or* • provides a correct solution based on an incorrect initial tessellation of the plane
3 (Meets Acceptable)	❑ Applies/develops **relevant** strategies and mathematical processes making **some** comparisons/connections that demonstrate a **basic** understanding ❑ Procedures are **basic** and may contain a **major error or omission** ❑ Uses **common** language to explain their understanding and provides **minimal** support for their conclusion	• provides a complete response to #1 *or* • provides a complete response to #3 *or* • provides a complete response to #3, based on an incorrect #1 *or* • provides a complete response to #2 and #3, with no evidence of #1
2 (Below Acceptable)	❑ Applies/develops **some relevant** mathematical processes making **minimal** comparisons/connections that lead to a **partial solution** ❑ Procedures are **basic** and may contain **several major mathematical errors** ❑ Communication is **weak**	• provides a complete response to #1, but the plane is not completely tessellated *or* • provides a complete response to #1, but the ratios are in incorrect proportions *or* • provides a partial solution to #1 and #3
1 (Beginning)	❑ Applies/develops an **initial start** that may be **partially correct** or could have led to a correct solution ❑ Communication is **weak or absent**	• provides a correct initial step to any part of one question

For student exemplars, go to www.mathlinks8.ca and follow the links.