Lesson Title: Proportions, Ratios & Rates **Part One**

Total Time: Two 50 Minute classes

Brief Description: In the first class, students will watch ***The House That STEM Built*** video titled *"Proportions, Ratios, & Rates"*. Throughout the video, there will be specific times to pause so the students can solve the problems outlined in the episode. In the second class, time will be provided to work on the floor plan project. Each student will create their own floor plan and solve the ratios needed for specific building materials.

Curriculum Outcomes: Taken from the New Brunswick Mathematics Grade 8 Curriculum

General Curriculum Outcomes: Develop Number Sense

Specific Curriculum Outcomes:

- N4- Demonstrate an understanding of ratio and rate
- N5- Solve problems that involve rates, ratios, and proportional reasoning

New Brunswick Global Competencies Achieved:
https://www2.gnb.ca/content/dam/gnb/Departments/ed/pdf/K12/curric/competencies/NBCompetencies.pdf?fbclid=IwAR1ldrZs1gFgiNm8rC4oz7Fmx6mSn-6t_QJkenev0eD33rZ-foYYn6bmdmc
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 solve complex problems by taking concrete steps to design and manage solutions.

Innovation, Creativity, and Entrepreneurship

- Learners enhance concepts, ideas, or products through a creative process.

Learning Objectives:
The learner will be able to:

- Create and solve ratios including three term ratios
- Understand proportional reasoning

Materials:

- Pencil/Pen
- Centimeter Graph Paper
- Loose Leaf Paper
- Calculator

Warm-up: 10 Minutes

- For a warm up question to get students thinking about ratios, ask students to create the following ratios:
    - Ratio of patterned shirts to solid color shirts in the room
    - Ratio of sneakers to open toe shoes in the room
    - The ratio of blue eyes to brown eyes to other colored eyes (green, grey, mixed, etc.) of people in the room

Activity: 35 Minutes

- Start watching ***The House That STEM Built*** video titled *"Proportions, Ratios, & Rates"*
- At minute 1:25, pause the video and have students solve for the hourly rate. Ask students to solve this question without using a calculator and show their work using long division or an alternative method. This activity should last **approx. 5 minutes**
    - Ask for a student to share their answer, either verbally or by coming to the front of the room and solving it on the whiteboard
- At minute 2:06, pause the video and have students copy the definition of ratio in their notes
- At minute 2:40, pause the video and have students solve the question to determine how many batts of insulation will be needed. This activity should last **approx. 5 minutes**
    - After a few minutes have passed, write on the whiteboard how the question should be set up for those who may be having difficulties.
    - Ask for a student to share their answer, either verbally or by coming to the front of the room and solving it on the whiteboard
- At minute 3:18, pause the video and have students solve why there would be 1000 shingles. This activity should last **approx. 3 minutes**
    - Ask for a student to share their answer
- At minute 3:49, pause the video and have students write a definition for three term ratio in their notes. This activity should last **approx. 5 minutes**
    - Since there is no written out definition in the video that can be directly copied, ask students to come up with their own definition
    - After a few minutes, ask students to share what they wrote down
    - After a few students have shared their own definition, work together as a class to create a final definition
    - Take this final definition and copy it on the whiteboard so that students who are struggling to write their own can have something to copy
    - A good definition that the teacher can use is, **A three term ratio is a ratio that compares three numbers that have the same units**
- After students have copied the definition of three term ratio, ask them the following question, "can three term ratios be represented by a fraction?"
    - **Answer** = No a three term ration cannot be represented by a fraction because three numbers are used to represent the ratio instead of two.
    - This serves as a good check-in question to see if students are

following along with the video and activities

- At minute 4:29, pause the video and have students write the definition for a proportional relationship. This activity should last **approx. 5 minutes**
    - Since there is no written out definition in the video that can be directly copied, ask students to come up with their own definition
    - After a few minutes, ask students to share what they wrote down
    - After a few students have shared their own definition, work together as a class to create a final definition
    - Take this final definition and copy it on the whiteboard so that students who are struggling to write their own can have something to copy
    - A good definition that the teacher can use is, A **proportional relationship occurs between two different variables that are both changing at the same rate.**
- At minute 4:56, pause the video and have students solve the number of nails needed for a 4 stud doorway.
- After the class has watched the video all the way through with the pauses to do work, replay the video all the way through again. This time do not pause the video. This will be the second time students have viewed the video.

Conclusion: 5 Minutes

- After the video has finished playing all the way through, introduce the following project to the students
    - The project associated with this video involves students creating a floor plan for a cabin or house.
    - The floor plan must have at least two rooms and three doorways. The doorways can be exterior (leading to the outside of the house) or can be interior doors leading into a room
    - Using their floor plan, students must use the ratios given in the video and determine how many shingles are needed*****, how much insulation is needed for the exterior walls, and how many nails are needed for the doorways
    - ***Assume** the roof is 1.5 times the area of the floor
- A suggested rubric is provided

Differentiation:

Content:

- Use ***The House That STEM Built*** video to discuss other examples and jobs that ratios are needed
    - For example
        - Investors/Bankers
        - Doctors/Nurses
        - Cooks/ Bakers

Practice:

- Some students may struggle to create their own floor plan. If they are

having trouble, the teacher can provide already created floor plans. The student can then take the plan and solve for the required calculations

Product:

- Some students may prefer to use a digital device to draw their floor plan and show their calculations
- Some students may prefer to use paper to draw their floor plan and show their calculations

Extension:

- Instead of creating a floor plan for a one story house, students could create 2-3 floor plans representing a 2-3 story house

Lesson Title: Proportions, Ratios & Rates **Part Two**

Total Time: 50 Minutes

Brief Description: In this second class, students will begin working on their floor plan projects. Students will create a floor plan for a cabin or house using graph paper. They will then create ratios for the number of shingles needed, the amount of insulation needed, and the number of nails needed for the doorways.

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General Curriculum Outcomes: Develop Number Sense

Specific Curriculum Outcomes:

- N4- Demonstrate an understanding of ratio and rate
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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.
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Innovation, Creativity, and Entrepreneurship

- Learners enhance concepts, ideas, or products through a creative process.

Learning Objectives:
The learner will be able to:

- Create and solve ratios including three term ratios
- Understand proportional reasoning

Materials:

- Pencil/Pen
- Centimeter Graph Paper
- Handout explain project requirements
- Loose Leaf Paper
- Calculator
- Colored pencils/markers/crayons

Warm-up: 10 Minutes

- Show students the full ***The House That STEM Built*** video titled *"Proportions, Ratios, and Rates"* without any pauses. This will be the third time they have viewed the video.
- Ask students if there are any questions about ratios, rates, or proportions
- Show students the exemplar floor plan project attached to this document
- Explain the requirements for the projects again
    - Create a floor plan that includes at least two rooms and three doorways
    - Using the floor plan, students must use the ratios given in the video and determine how many shingles are needed, how much insulation is needed, and how many nails are needed for the doorway framing
- Pass out graph paper to all students
- Pass out the handout titled **Proportions, Ratios & Rates Project** to all students. This handout outlines the project so all students will be able to keep track of the requirements
    - The given ratios from the video are on this handout. The teacher should still write out the given ratios on the whiteboard in case students lose the handout
    - The given ratios are
        - Shingles: On average 1 shingle covers 3 square feet (1:3)
        - Insulation: On average 1 batt of insulation for every 3 studs (1:3)
        - Doorway: On average, 2 studs needs 6 nails (2:6)
            - Remember, each doorway has double studs on each side of the doorway for extra support (4:12)

Activity: 35 Minutes

- Students will be using this time to work on their project
- Students should be allowed to use resources such as textbooks, notes, and their mobile devices if they would like to rewatch the video again
- If students finish early, they can find another student who is also finished. They can quietly share their floor plans with each other and check if the math is done correctly
- While students are working, the teacher should be circulating the room to ensure students are staying on task and to answer any questions

Conclusion: 5 Minutes

- Collect any work that is completed
- Ask students if there are any final questions
- Provide students with the due date of the teachers choosing

Differentiation:

Content:

- Use ***The House That STEM Built*** video to discuss other examples and jobs that ratios are needed
    - For example
        - Investors/Bankers
        - Doctors/Nurses
        - Cooks/ Bakers

Practice:

- Some students may struggle to create their own floor plan. If they are having trouble, the teacher can provide already created floor plans. The student can then take the plan and solve for the required calculations

Product:

- Some students may prefer to use a device to draw their floor plan and show their calculations
- Some students may prefer to use paper to draw their floor plan and show their calculations

Extension:

- Students may want to show off their floor plans to multiple different people, if that is the case, another day could be used as a “floor plan fair”. Start the class with putting students into groups of six. Within that group of six, each person will be given 5 minutes (or any desired amount of time) to present their floor plan. They can discuss their plan along with the math steps used to solve the problems. After the desired amount of time is given, a different person in the group will present. Repeat this process until all members of the group have presented to each other.
- Students can draw another floor plan and hand it to the teacher without any calculations done. The teacher will distribute the floor plans randomly to other students. The students then must solve the calculations for the new floor plan

Name: _____ Class:_____ Date:_____

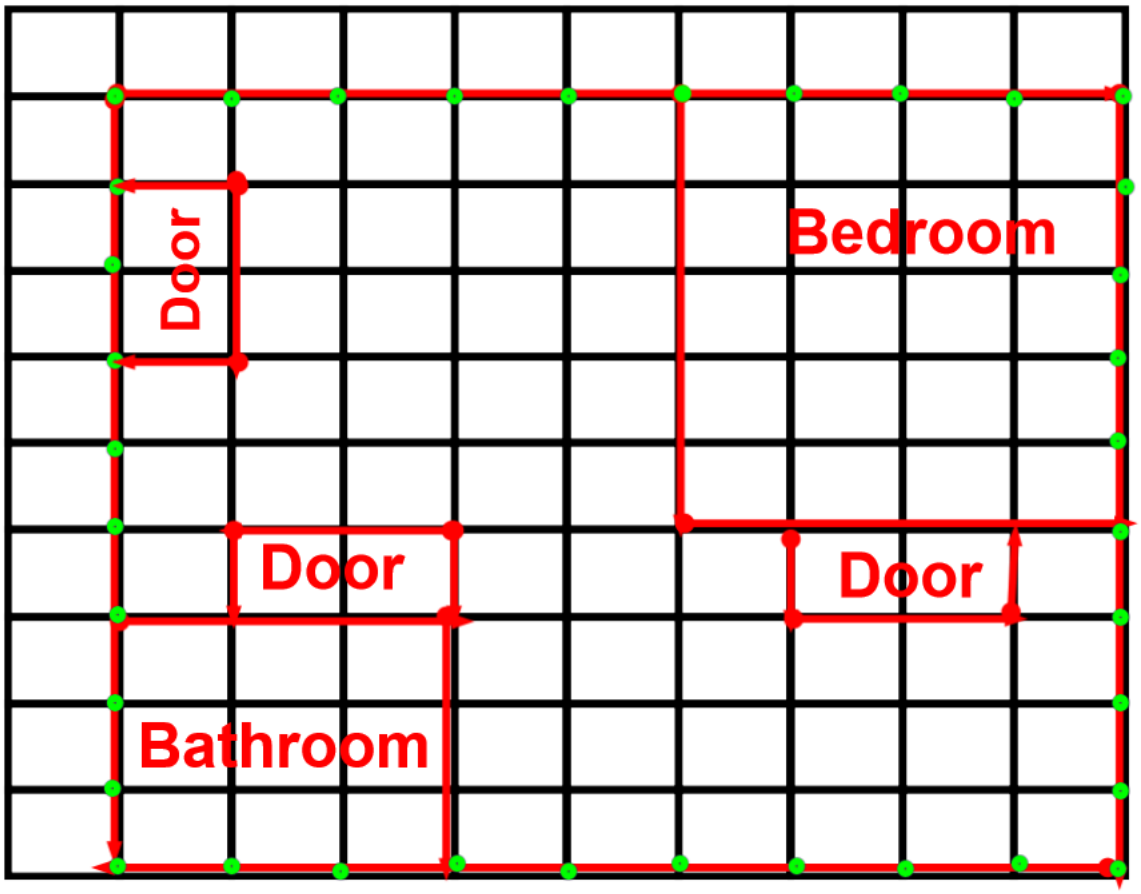
Proportions, Ratios & Rates Project

Requirements:

- Using graph paper, design a floor plan for a one story house
    - Each square represents **16 inches or 1.33 feet**
    - Each lime green dot on the graph paper represents **1 stud**
    - Your floor plan must have at least 3 doorways and 2 rooms
    - The roof is going to be 1.5 times the area of the floor
- Using your floor plan and the ratios provided in the video, solve the ratios for the shingles and insulation needed, and studs for the doorways
    - Shingles: On average 1 shingle covers 3 square feet (1:3)
    - Insulation: On average 1 batt of insulation for every 3 studs (1:3)
    - Doorway: On average, 2 studs need 6 nails (2:6)
        - Remember, each doorway has double studs on each side of the doorway for extra support (4:12)

Please Show All Calculations:

Proportions, Ratios & Rates Project Exemplar



D = Doorway

Shingles:

Each square = 1.33 feet
There are 9 squares per side of the house
1.33 feet x 9 = 12 feet per side of the house
Area = length x width
12 feet x 12 feet = 144 ft^2
Roof is 1.5 times the area of floor
144ft^2 x 1.5 = 216ft^2
On average 1 shingle : 3 ft^2
216 / 3 = 72
My House would need 72 shingles

Insulation:

My house has 36 studs around the perimeter
On average 1 batt :3 studs
36 is 12 times greater than 3
1 batt x 12 = 12 batts
3 stud x 12 = 36 studs
My house's insulation ratio is 12 batts: 36 studs

Doorway:

On average, 2 studs : 6 Nails
For one complete doorway, 4 studs : 12 nails
My house has 3 doorways
If one complete doorway is 4 studs : 12 nails
3 completed doorways would be:

4x3 = 12
12x3= 36

My house's ratio would be 12 studs : 36 nails

Proportions, Ratios & Rates Project Rubric

This is a suggested rubric. Teachers may create their own if they choose

- Rubric was adapted from Emily McGary Allman for distribution on www.TeachersPayTeachers.com, 2012

	1- Working Below Expectations	2- Approaching Expectations	3- Meeting Expectations	4- Exceeding Expectations
Mathematical Content	-The evidence shows limited understanding of the mathematical concepts. -There are significant mathematical errors -A few of the problems are not attempted	-The evidence shows some understanding of the mathematical concepts -There are minor mathematical errors -Most of the problems are attempted	-The evidence shows a nearly complete understanding of the mathematical concepts -There are minor mathematical errors but all problems were attempted	-The evidence shows a complete understanding of the mathematical concepts -There are no mathematical errors -All problems were attempted and solved correctly
Problem Solving	-There is little identification of the important elements of the mathematical problem - An inappropriate strategy was chosen for solving the problem	-Some of the important elements of the mathematical problem are identified -The chosen strategy for solving the problem was not used properly	-Most of the important elements of the mathematical problem are identified -The chosen strategy for solving the problem was generally used correctly	-All of the important elements of the mathematical problem were identified -The chosen strategy for solving the problems as consistently used correctly

Comments: