Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.

DETAILED LESSON PLAN: HOT SAUCE!

Is Mr. Davis' perceived heat rating proportional to the Scoville heat rating?

Students will benefit greatly from getting into the habit of analyzing a data set by looking for a constant ratio between the dependent and independent variables. In *Hot Sauce!*, Wilbur Davis is a professional taste-tester, making his debut as a hot sauce tester for the Screamin' Hot Hot Sauce Company. Each hot sauce has a particular Scoville rating, as set by the company, and Mr. Davis is to rate his perceived hotness of each sauce on a scale of 1 to 100. Jeanette and Marty, of the hot sauce company, are aiming to have the perceived heat rating be proportional to the Scoville heat rating. The data provided is Marty's notes which show the Scoville heat rating for each hot sauce as well as Mr. Davis' perceived heat rating.

Lesson Plan Overview

Lesson Length: 4 Days

Prerequisite Standards

- 6.RP.A.2, 6.RP.A.3, 7.RP.A.1

Vocabulary

- **Proportional relationship:** A relationship between two variables that vary directly with each other; when two variables have a constant ratio between them.

Vocabulary Protocols:

- In your math classroom, make a Word Wall to hang and refer to vocabulary words throughout the lesson. As a whole-class exercise, create a visual representation and definition once students have had time to use their new words throughout a lesson.
- In the *Practice Printable*, remind students that key vocabulary words are highlighted. Definitions are available at the upper right in their student account.
- In the *Student Reflection*, the rubric lists the key vocabulary words for the lesson. Students are required to use these vocabulary words to explain, in narrative form, the math experienced in this lesson. During "Gallery Walks," vocabulary can be a focus of the "I Wonder..., I Notice..." protocol.

Applying Standards for Mathematical Practice

SMP 7

Look for and make use of structure.*

In *Data & Computation*, students are asked to draw a visual representation that is connected to the data. As students look for patterns apparent in the visual, they begin to see the underlying structure (a graph) that helps them determine if the pattern is proportional (linear). In *Resolution*, students apply Jo Boaler's tip for SMP7 as they share different ways they solved the problem. They are encouraged to look for structures that help illustrate proportional relationships.

Mathematical Practice Tip from Jo Boaler: SMP 7

When students see how other students notice different patterns and structures from the same visual they are better able to appreciate and understand the structure of mathematics.

Many students are intimidated in trying to understand a pattern or structure. One key to unlocking this type thinking is to present interesting, data, visuals or number situations, and ask students how they see it. This will encourage the visual pathways in students' brains to be active, and when someone brings numbers into the conversation it will encourage brain connections. Ask students share how they see patterns and ideas, to help them to connect the different ideas from which a common structure emerges. After these practices, it is possible to present students with more complex and abstract mathematical tasks to discover familiar patterns and structures.

Here are some recommendations:

1. An activity I recommend, to help students attend to structure, is either a dot card talk, a number talk or a data talk. Present students with a collection of dots, or a pattern and ask them how they see it. Ask students if anyone saw the pattern, numbers, or data differently.
2. Whenever you or students are sharing mathematical ideas ask students – *Can anyone see another way to see or solve this? V*alue the different ways of thinking that emerge.
3. If students are unsure about presenting ideas, ask them to present in pairs or groups.
4. When students present ideas ask the presenter or other students in the room – *Why does that work*?
5. When more than one method or visual emerges from a discussion ask students – *How are they connected*?

When students share together and see mathematics as a subject of ideas and communication they become much less intimidated.

Video Highlight: Jo teaching a dot card number talk to middle school students. (Run time: 5 min, 58 sec)
https://www.youcubed.org/resources/jo-teaching-visual-dot-card-number-talk/

Cluster Connection

Cluster Heading: Analyze proportional relationships and use them to solve real-world and mathematical problems.

- **Direct Connection:** In *Hot Sauce!*, students will analyze the hot sauce data to determine whether or not it is proportional.
- **Cross-Cluster Connection:** This activity connects 7.RP.A to 6.EE.C as students use variables to represent quantities and relationships in equations and analyze the relationships in tables and graphs.

Common Misconceptions

- Students may not realize that proportional data may not always explicitly show (0, 0) in the table. Encourage students to either graph the data to see if it goes through the origin or to calculate the *y/x* ratios for each data pair to see if they are equivalent.
- Students may assume any straight line represents a proportional relationship, regardless of whether it passes through the origin. Ask students to find the *y/x* ratios for each data point to see if the ratios are equivalent.

Supporting Diverse Learners

Accommodations, Modifications and Extensions for English Learners (EL) and Special Populations

These supports may be appropriate for all students. Accommodations, modifications, and extensions are provided by curriculum component. Please consider additional supports where you find them appropriate for your students.

Note: Strategies contained in this section are appropriate for English Learners and students who are receiving services under the Federal Individuals with Disabilities Education Act (IDEA), Section 504 of the Rehabilitation Act of 1973, and state laws governing Talented and Gifted education.

Component	Accommodations/Modifications	Extensions
Test Trainer Pro	*Test Trainer Pro* automatically adapts to student ability level as students move through questions. Instruct students to work in a lower grade level or Core Skills (Grades 1-4) as needed.	*Test Trainer Pro* automatically adapts to student ability level as students move through questions. Instruct students to work in a higher grade level or Algebra I as needed.
The Math Simulator Immersion	Access Closed Caption and Spanish Subtitles within the video. Reinforce vocabulary in action: • *Circuit*: a planned route of events. • *Palate*: the roof of the mouth. • *Scoville rating*: a scale for rating the relative strong taste of peppers.	
The Math Simulator Data & Computation	Provide pre-labeled graph paper. Consider providing students with a calculator.	Withhold guiding questions from students. Have students make two different visual representations for the problem.
The Math Simulator Resolution	Access Closed Caption and Spanish Subtitles within the video.	
Simulation Trainer	Pair students to allow for peer teaching and support. Provide pre-labeled graph paper. Consider providing students with a calculator.	Have more proficient students on this skill coach less successful students.
Practice Printable	Upon completion of the first page (Procedure #1), consider following the *Exit Ticket Differentiation Plan*. For the first page, provide pre-labeled graph paper. For the first page, consider providing students with a calculator.	Upon completion of the first page (Procedure #1), consider following the *Exit Ticket Differentiation Plan*. Have students create additional, more difficult word problems like those on the second page. Have them exchange problems to solve.

Component	Accommodations/Modifications	Extensions
Practice Printable (cont'd)	For the second page, consider enlarging the page to provide room to work out problems. For the second page, provide blank graph paper. For the second page, read word problems aloud.	
Clicker Quiz	Have more proficient students on this skill coach less successful students.	Have more proficient students on this skill coach less successful students. Have students create their own Clicker Quiz for this lesson.
Student Reflection	Pair students to allow for peer teaching and support. Consider allowing EL students to write the narrative in their native language, then use a digital translator to help them transcribe it into English.	Have more proficient students on this skill coach less successful students.

Applying Mathematical Language Routines (MLRs)

While MLRs apply to all students, they are particularly beneficial for EL and other special populations. A full description of the MLRs is available in the Teacher Guide with a rationale for their use.

MLR 7

Compare and Connect

During *Data & Computation*, students are using the Sketch It! protocol to determine whether a relationship is proportional or not. Their visual also includes the story behind their work. They then share their work in small groups.

Suggestion: Have students compare and contrast the differences between their mathematical methods and representations. Have them discuss what is similar and what is different in their stories and in their visual representations. Prompt them to explain one another's strategies to you.

Instruction at a Glance


Gladys Graham


Kevin Simpson


Megan LeBleu

Gladys: Don't allow students to assume that not seeing (0, 0) in a table or on a graph means a relationship is not proportional.

Kevin: Students may struggle with the difference between additive reasoning and multiplicative reasoning. Help them understand that although additive relationships can form a line, the line won't go through the origin and the ratios between values won't be equivalent.

Megan: There are several ways to test for equivalent ratios. Take (2,4) and (6, 12).
1) Scale factor between ratios 2:4 --> × 3 --> 6:12
2) Scale factor between terms 2 × 2 = 4 and 6 × 2=12
3) Common unit rate 4/2 = 2 12/6 =2

Clicker Quiz

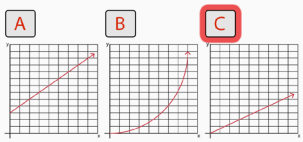
The recipes have been revised and tested. Is the relationship between the two heat ratings proportional?

Screamin' Hot Hot Sauce Co.

Hot Sauce	Scoville Heat Rating	Human Perceived Heat Rating
Barely Burnin'	0	18
Sorta Stealin'	50,000	36
Crazy Smokin'	100,000	54
Fire Baby Fire	150,000	72
Wicked Hot	200,000	90

A Yes B No C Not enough information

Which graph shows a proportional relationship?



A B C D None of these

Which table shows a proportional relationship?

A		B		C	
x	y	x	y	x	y
0	0	0	0	0	0
3	9	2	2.4	1	1/4
5	15	5	6	2	1/2
8	24	6	7.2	3	3/4
10	30	9	10.8	4	1

D All of these

The table shows a proportional relationship.

x	0	4	6	9
y	0	8.4	12.6	18.9

Which point of data would lie on this line?

A (15, 30.15) B (12, 25.2) C (15, 32.4) D (12, 24.12)

The data set shows a proportional relationship.

{(0, 0), (3, 51), (4, 68), (6, 102), (10, 170)}

What is the constant ratio between y and x?

A 48 B 17 C 35 D 24

Two variables have a proportional relationship when:

A The graph is a straight line through the origin.
B The ratio between them is constant.
C They are both even.
D Both A and B
E Both A and C

Practice Printable

Full-sized Answer Key available in printed Teacher's Guide

Name _____ Date _____ Period _____

HOT SAUCE!

Is Mr. Davis' perceived heat rating proportional to the Scoville heat rating?

After his first hot sauce taste test, professional taste-tester Wilbur Davis is now addicted to hot sauce! He can't get enough. He has again signed up with Screamin' Hot Hot Sauce Company to test the new sauces!

Marty and Jeanette, of the Screamin' Hot Hot Sauce Company, are still aiming for a proportional relationship between the human-perceived heat rating and the Scoville heat rating.

Use Marty's notes to determine if Mr. Davis' perceived heat rating is proportional to the Scoville heat rating, and explain your reasoning.

7.RP.A.2a
About this standard
Decide whether two quantities are in a proportional relationship, (e.g. by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin).

Screamin' Hot Hot Sauce Co.

Hot Sauce	Scoville Heat Rating	Human Perceived Heat Rating
Head Shakin'	0	0 ← goes through the origin
Nose Scratchin'	50,000	24 $\frac{24}{50,000}$ = 0.00048
Jaw Droppin'	100,000	48 $\frac{48}{100,000}$ = 0.00048
Eye Poppin'	150,000	72 $\frac{72}{150,000}$ = 0.00048
Face Meltin'	200,000	96 $\frac{96}{200,000}$ = 0.00048

Mr. Davis' perceived heat rating is proportional to the Scoville heat rating. The ratios between the human-perceived heat ratings and the Scoville heat ratings are all equivalent.

Name _____ Date _____ Period _____

APPLYING THE STANDARD

How might this standard appear on a test?


CHECK OUT MY WORKED EXAMPLE #1b

1) Look at each representation, and determine whether y is proportional to x. Write either *proportional* or *not proportional*.

a) 
Not proportional

b) 
Not proportional

c) 
Proportional

d)

x	0	2	5	7	10
y	0	6	10	16	18

Not Proportional

e) $1.5x = y$ Proportional

f) $y = 5x + 2$ Not proportional

g) $y = 20x$ Proportional

h)

x	1	3	4	6	12
y	8	24	32	48	96

Proportional

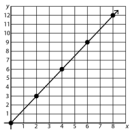
2) The graph and the table each show a proportional relationship.

a)

x	y
0	0
2	58
5	145
7	203
15	435

Determine another ordered pair in this data set. Write the coordinates.

Answers will vary. (x, 29x)

b) 
Determine another point on the line. Write the coordinates.

Answers will vary. (x, 1.5x)

3) Workout World charges gym members $10 to sign up and then $20 every month. Good-To-Be-Fit charges their members $30 per month, with no sign-up fee.

a) For each company, complete the table showing the total amount paid over six months. Then write an equation that models the total cost (y) for any number of months (x).

Workout World Gym Costs

Number of Months	1	2	3	4	5	6
Total Cost ($)	30	50	70	90	110	130

Equation: $y = 20x + 10$

Good-To-Be-Fit Gym Costs

Number of Months	1	2	3	4	5	6
Total Cost ($)	30	60	90	120	150	180

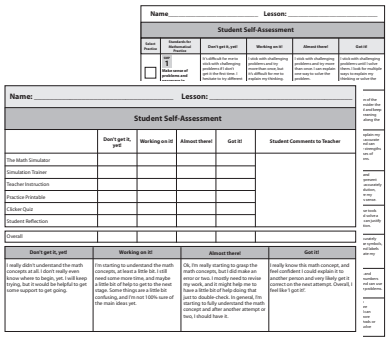
Equation: $y = 30x$

b) For which company is the total cost proportional to the number of months? How do you know?

Good-To-Be-Fit has a proportional relationship because the ratio between the two variables is constant, and the line would go through the origin.

Student Self-Assessment

Student Self-Assessments are an excellent way for teachers to gauge student learning. In combination with qualitative and quantitative data from the assignments, teachers can form a clear picture of student needs and follow-up appropriately. These self-assessments, if completed by students throughout a lesson, not only provide the teacher with useful information, but also improve student self-monitoring of learning.



Name_____ Lesson: _____

Student Self-Assessment

Active Practice	Standards for Mathematical Practice	Don't get it, yet!	Working on it!	Almost there!	Got it!
☐	SMP 1 Make sense of problems and persevere	It's difficult for me to understand the problem. If I don't get it the first time, I...	I stick with challenging problems for a while and then move on. It's difficult for me to explain my thinking.	I stick with challenging problems and I usually find my way to solve the problem.	I stick with challenging problems and I usually find my way. I look for multiple ways to explain my thinking as I do my

Name: _____ Lesson: _____

Student Self-Assessment

	Don't get it, yet!	Working on it!	Almost there!	Got it!	Student Comments to Teacher
The Math Simulator					
Simulation Trainer					
Teacher Instruction					
Practice Printable					
Clicker Quiz					
Student Reflection					
Overall					

Don't get it, yet!	Working on it!	Almost there!	Got it!
I really didn't understand the math concept, and I'm confident that I don't know where to begin, yet. I will keep trying, but it would be helpful to get some support to get going.	I'm starting to understand the math concept, but I'm not confident yet. I still need some more time, and maybe a little bit of help to get to the next stage. Some things are a little bit confusing, and I'm not 100% sure of the main ideas yet.	Ok, I'm really starting to grasp the math concept, and I only made a few errors or two. I mostly need to revise my work, and it might help me to have a little bit of help doing that just to double-check. In general, I'm starting to fully understand the math concept and after another attempt or two, I should have it.	I really know this math concept, and I am confident in explaining it to another person and very likely get it correct on the next attempt. Overall, I feel like I got it!

Materials

- *Student Self-Assessment*
- Pencil

Standards Assessed:

- 7.RP.A.2a
- SMP 7 (*The Math Simulator*)

Recommendations for Use:

Mathematical Standard

1. Distribute the *Student Self-Assessment* at the beginning of the lesson and fill in Name and Lesson title.
2. After each lesson component (*The Math Simulator, Simulation Trainer, Teacher Instruction, Practice Printable, Clicker Quiz, Student Reflection, Overall*), give students the opportunity to reflect on their perceived proficiency and knowledge of the content.
3. Ask students to mark their perceived proficiency or knowledge of the content, according to the scale provided (*Don't get it, yet!, Working on it!, Almost there!, Got it!*).
4. Students may then write any additional comments about their learning in the space provided.

Standards for Mathematical Practice

1. After students have completed a component that utilizes a specified SMP (as indicated above), have students mark the column on the SMP side of the *Student Self-Assessment,* to indicate the Standards for Mathematical Practice emphasized in that component.
2. Ask students to read through the various descriptions for that particular SMP and then mark the description that best describes their degree of use of the practice.
3. Repeat for other SMPs used in other lesson components.

Recommendations for Follow-Up:

Don't get it, yet!

Students in this learning phase require personal tutoring.

Partner with a classmate who rated themselves in the **Got it!** category. Review with your partner:

7.RP.A.2a Hot Sauce! Math Simulator

- Watch the *Immersion* video, and explain the story and the question.
- Review the class WorkPads, and discuss strategies used to solve the problem.
- Watch the *Resolution* video, and revise your work.

Working on it!

Students in this learning phase need focus in conceptual work.

Create a personal visual glossary for lesson vocabulary.

7.RP.A.2a Vocabulary Words: Proportional relationship

- Look up each word in the student glossary.
- Read the definition and think about its meaning.
- Draw a picture that illustrates the meaning.

Almost there!

Students in this learning phase need practice with procedures.

Review the *Worked Example* video in the *Practice Printable* assignment and the written *Example Problem* in the *Student Workbook*:

7.RP.A.2a Hot Sauce! Worked Example

Compare your thinking to the video and the written solution.

- Identify any places where you have made mistakes.
- Correct any mistakes you have made on the *Practice Printable*.

Got it!

Students in this learning phase can reinforce their learning by teaching others.

Partner with a classmate who rated themselves in the **Don't get it yet!** category. Review with your partner:

7.RP.A.2a Hot Sauce! Math Simulator

- Watch the *Immersion* video, and ask them to explain the story and the question.
- Review the class WorkPads, and discuss strategies used to solve the problem.
- Watch the *Resolution* video, and have your partner revise their work.

Test Trainer Pro

Allow 7 to 10 minutes

As a warm-up, tell students to log into their account and access *Test Trainer Pro*. Specify the domain in which you would like students to work (preferably a different one than the prior day) and also the length of time you wish students to work (not a number of items). It is important to remind students to work out the math using paper and pencil when necessary and to look at their feedback.

The Math Simulator™

Allow 45 minutes

1 Immersion

Materials

- *Hot Sauce! Immersion* video
- Chart paper/Interactive whiteboard

Procedure

1. Play the *Immersion* video to the whole class.
2. Restate the question and keep it visible: *Is Mr. Davis' perceived heat rating proportional to the Scoville heat rating?*
3. Use the **Think-Pair-Share** protocol. Ask students: *What do we need to know? What do you think it means for the two ratings to be "proportional?"*

Think-Pair-Share
Ask students to think individually about what information they need to know and make some notes (≈ 1-2 min). Tell students to pair with a partner and discuss their notes (≈ 2 min). Finally, facilitate whole-class by cold-calling on students to share their strategies on an interactive board (≈ 2 min).

2 Data & Computation

Screamin' Hot Hot Sauce Co.

Hot Sauce	Scoville Heat Rating	Human Perceived Heat Rating
Carolina Green	0	0
Habañero Hazard	50,000	10
Blazing Burmese	100,000	25
Atomic Gold	150,000	45
Moroccan Face Melter	200,000	75

Materials

- Copies of *Hot Sauce! Data Artifact*, one per student

Procedure

1. Distribute the *Data Artifact* to each student.
2. Use the **Sketch-it!** protocol to have student pairs create a visual representation that illustrates what is occurring in the data, between Mr. Davis' ratings and the Scoville rating. Have them determine if the ratings are proportional.
3. Observe students at work. As students explain their reasoning to you and to classmates, look for opportunities to clarify their vocabulary. Allow students to 'get their idea out' using their own language but when possible, make clarifying statements using precise vocabulary to say the same thing. This allows students to hear the vocabulary in context, which is among the strongest methods for learning vocabulary. Also ask students clarifying questions to further their thinking.
    - *What patterns do you notice in the Scoville heat rating?*
    - *What patterns do you notice in Mr. Davis' human-perceived heat rating?*
    - *As the Scoville rating increases, how does Mr. Davis' heat rating change? By how much?*
    - *What would this data look like on a graph?*
    - *What does it mean for two variables to be proportional?*

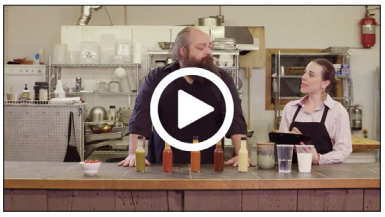
4. Have a few pairs briefly share their visual, explaining how its structure illustrates the hot sauce data, and how it led them to determine if the relationship is proportional. Ask if anyone else used a different visual they want to share.

Sketch It!
Tell students to draw a picture that includes both the story and math components that create a visual representation of the math concept (≈ 5-7 min). Have students share their work in small groups.

3 Resolution

Materials

- *Hot Sauce! Resolution* video



Procedure

1. Play *Resolution* video to the whole class, and have the students compare their solutions as they watch.
2. After the video, prompt students with the following questions:
   - *Write a sentence or two describing what it means for two variables to be in a proportional relationship.*
   - *What type of visuals or structures do you think best illustrate proportional relationships?*

Students may respond aloud or in a journal.

Answer:
Mr. Davis' perceived heat rating is not proportional to the Scoville heat rating. When graphed, the two quantities do not form a straight line through the origin, and the ratios between the two quantities are not equivalent.

Student Self-Assessment

- Refer to the instructions for the *Studenf Self-Assessment* (on a prior page of this lesson plan).
- Allow students time to assess their level of knowledge after having completed this component.
- Collect the self-assessment from students, or have them keep it for later components.

Test Trainer Pro

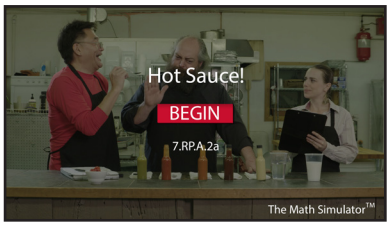
Allow 7 to 10 minutes

As a warm-up, tell students to log into their account and access *Test Trainer Pro*. Specify the domain in which you would like students to work (preferably a different one than the prior day) and also the length of time you wish students to work (not a number of items). It is important to remind students to work out the math using paper and pencil when necessary and to look at their feedback.

The Math Simulator™

Simulation Trainer

Allow 25 to 35 minutes



Materials

- *Hot Sauce! Simulation Trainer*
- Student Devices
- Paper and Pencil
- Student Headphones

Procedure

1. Assign the *Simulation Trainer* to all students.
2. Tell students to navigate to the *Simulation Trainer* assignment.
3. Have students work individually to start.
4. Consider using varied protocols that include peer teaching.
5. Use *Progress Monitoring* on the *Teacher Dashboard* to determine which students are having difficulty. Provide individual help when necessary.

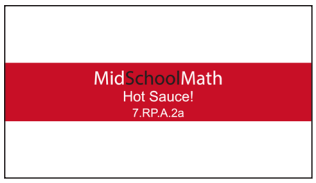
Student Self-Assessment

- Refer to the instructions for the *Studenf Self-Assessment* (on a prior page of this lesson plan).
- Allow students time to assess their level of knowledge after having completed this component.
- Collect the self-assessment from students, or have them keep it for later components.

Teacher Instruction

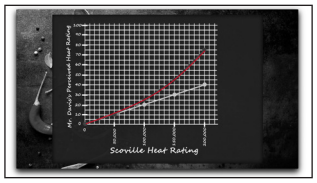
Allow 10 to 15 minutes

Consider this sample lecture to accompany the slide deck in the *Teacher Instruction* component. You may deliver the slide deck yourself, watch the video as a class, or assign the video to student devices. Alternatively, you may create and deliver your own concise, brief lecture using any method you see fit.

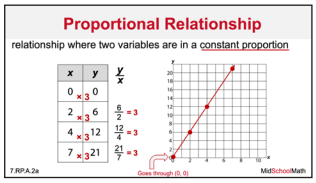


We're going to take a deeper look at the math we used in *Hot Sauce!*.

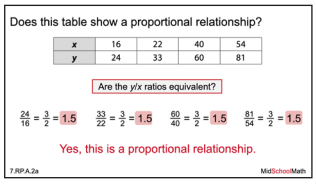
In *Hot Sauce!*, Mr. Davis is a taste-tester for hot sauce and has to rate how hot he thinks each sauce is.



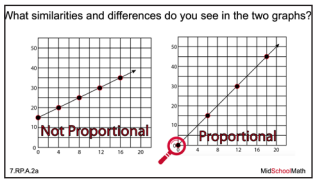
We had to determine if Mr. Davis' human-perceived heat rating was proportional to the Scoville heat rating, set by the hot sauce company.
To tell if the human rating and Scoville rating had a proportional relationship, we could look at a graph of the information. We saw that it curved instead of it being a straight line through (0, 0), so we could say the relationship wasn't proportional.
In addition to being able to look at a graph, we looked at each data pair and calculated the *y*-over-*x* ratios to see if they were equivalent. When we divided the ratios of the human rating and the Scoville rating, we saw the ratios were not equivalent. So again, we could see this relationship was not proportional.



What is a proportional relationship? Two variables have a proportional relationship when the values are in a constant proportion.
One way to see if there is a constant proportion, is to look at a table of values, like the one we see here. We make *y*-over-*x* ratios for every data pair, except (0, 0) because 0 should never be in the denominator. So the *y*-over-*x* ratios for this relationship are 6 over 2, 12 over 4 and 21 over 7. We can now divide these ratios, and we see that they all equal 3, which means the constant proportion of this relationship is 3. It tells us that the *x*-values are each multiplied by 3 to get the *y*-values.
Another way to see if two variables have a proportional relationship is to look at the data values on a graph. If the points go through the origin (0, 0), and if they form a straight line, like this one does, then the relationship is proportional.
So equivalent ratios and a straight line though the origin tell us that two variables have a proportional relationship.



Let's look at a different example.Does this table show a proportional relationship?
Remember, to be proportional, the two corresponding quantities for the two variables need to have a constant ratio. Let's determine the *y*-over-*x* ratio for each data pair.
We can start by writing a ratio for each pair with the *y*-value in the numerator and the *x*-value in the denominator. Then we can simplify or divide to see the final value.
We see that each ratio has a value of three-halves or 1.5. Because all the ratios are equivalent, we know this is a proportional relationship.
[NOTE TO TEACHER: Students may benefit from seeing this data entered on Desmos or a graphing calculator to see the line formed.]



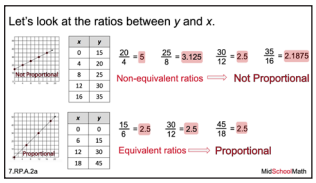
Let's take a look at two different graphs. What similarities and differences do you see between them? *[Pause here. Allow students time to think and respond. They will likely say that both graphs show straight lines; both have dots; both go up; one has 5 points but the other has 4 points; one starts at (0, 0) but the other does not, etc.]*
Some similarities we see are:

- Both show straight lines
- Both have dots or points
- Both lines are going up from left to right

Some differences we see are:

- The graph on the left has 5 points, while the graph on the right has 4 points
- The graph on the left doesn't go through the origin (0, 0). The graph on the right does go through the origin (0, 0).

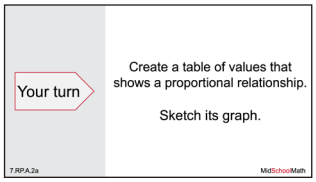
Our observations tell us that the graph on the left does not show a proportional relationship, even though it's a straight line, because it does not go through the origin. The graph on the right does show a proportional relationship because it shows a straight line that does go through the origin.



The graphs already told us that we have one non-proportional relationship and one proportional relationship. But let's look at the data values for each relationship and compare the *y*-over-*x* ratios.

Remember that we can't have zero in the denominator, so we'll leave the first data pair alone. For the rest, we'll put the *y*-value in the numerator and the *x*-value in the denominator. Then, we can simplify or divide each ratio so we can compare the values. We see that the ratios for the first table are not equivalent, which again tells us this relationship is not proportional.

Now we can compare the ratios for the second relationship. Again, we skip the entry where 0 would be in the denominator, but form the *y*-over-*x* ratios for the other data pairs. After dividing each ratio, we can see the ratios are equivalent. This tells us that this relationship is proportional and that the constant proportion is 2.5.



Now it's your turn.

Note: Feel free to modify this part to suit your needs. You may even want to change this entirely to another activity or question.

Student Self-Assessment

- Refer to the instructions for the *Studenf Self-Assessment* (on a prior page of this lesson plan).
- Allow students time to assess their level of knowledge after having completed this component.
- Collect the self-assessment from students, or have them keep it for later components.

Test Trainer Pro

Allow 7 to 10 minutes

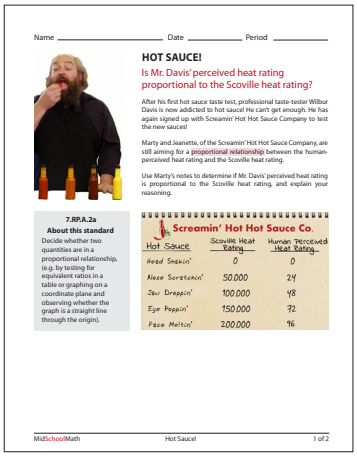
As a warm-up, tell students to log into their account and access *Test Trainer Pro*. Specify the domain in which you would like students to work (preferably a different one than the prior day) and also the length of time you wish students to work (not a number of items). It is important to remind students to work out the math using paper and pencil when necessary and to look at their feedback.

Practice Printable

Allow 35 minutes

Materials

- Copies of *Hot Sauce! Practice Printable*, 1 per student


Name _____ Date _____ Period _____

HOT SAUCE!

Is Mr. Davis' perceived heat rating proportional to the Scoville heat rating?

After his first hot sauce taste test, professional taste-tester Wilbur Davis is now addicted to hot sauce! He can't get enough. He has again signed up with Screamin' Hot Hot Sauce Company to test the new sauces!

Marty and Jeanette, of the Screamin' Hot Hot Sauce Company, are still aiming for a proportional relationship between the human-perceived heat rating and the Scoville heat rating.

Use Marty's notes to determine if Mr. Davis' perceived heat rating is proportional to the Scoville heat rating, and explain your reasoning.

7.RP.A.2a
About this standard
Decide whether two quantities are in a proportional relationship, (e.g. by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin).

Screamin' Hot Hot Sauce Co.

Hot Sauce	Scoville Heat Rating	Human Perceived Heat Rating
Head Shakin'	0	0
Nose Scratchin'	50,000	24
Jaw Droppin'	100,000	48
Eye Peepin'	150,000	72
Face Meltin'	200,000	96

MidSchoolMath Hot Sauce! 1 of 2

Procedure

1. Distribute copies of the *Practice Printable*. Have students work through the first page.
2. Self-Rating: Ask students to rate their personal understanding of the problem on a scale of 1 to 3.
   - 1 = I need more help
   - 2 = I need more time, yet mostly understand
   - 3 = I've got this!

   Have students put the number on their *Practice Printable.*
3. Have students sort themselves based on the student self-rating and professional teacher judgment of accuracy of the response. This sorting can be used for grouping students for differentiation of instruction.
4. Implement the **Practice Printable Differentiation Plan** (see below) as students finish the *Practice Printable*.
5. Collect completed *Practice Printable*.

DON'T FORGET TO ASSIGN MY WORKED EXAMPLE!

Manipulative Task for Digital WorkPad

Have students return to Problem #1d on the *Practice Printable* and use the *WorkPad* to visually represent the data pairs on a graph, determining if it is a line through the origin. Students could use the grid background, the Line tool, and the Text tool to create and label the axes for Quadrant I. They could then use the Two-Color Counters to plot each data pair in the table. To check for proportionality, they could use the Line tool to see if the points can be connected with a straight line passing through the origin.

Student Self-Assessment

- Refer to the instructions for the *Studenf Self-Assessment* (on a prior page of this lesson plan).
- Allow students time to assess their level of knowledge after having completed this component.
- Collect the self-assessment from students, or have them keep it for later components.

Practice Printable Differentiation Plan

Remediation

Meet with students who were unsuccessful on the first problem in a small group. Consider using whiteboards to work through problems on the *Practice Printable* together.

Practice

Students who completed the first problem but need more practice should spend the class period completing the *Practice Printable*. Encourage them to confirm strategies and solutions with each other. Any additional time remaining should be spent getting started on the *Student Reflection*.

Enrichment

Students who demonstrated confident mastery on the first problem can finish the *Practice Printable* and spend the remaining time getting started on the *Student Reflection* or completing the following:

- Have students list real world situations in which they may calculate unit rate and create a word problem using that scenario.
- Provide the students flyers from grocery stores and ask them to compare which brand of a particular item is a better deal.
- Provide students graph paper and ask them if they can graphically represent one of the unit rates relationships from the Practice Printable.

Student Reflection

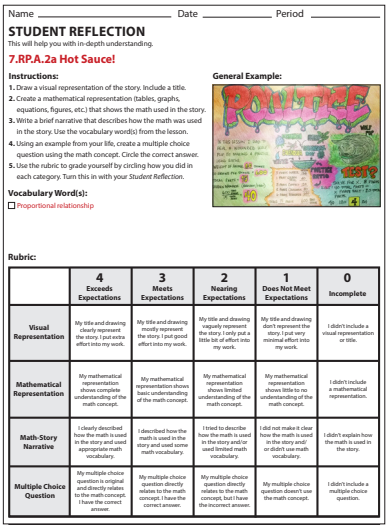
Allow 10 minutes (optional)

Materials

- Copies of *Student Reflection* rubric, 1 per student
- White Paper
- Colored Pencils

Procedure

1. Available in the *Student Reflection* lesson on Teacher Dashboard, print and distribute the rubric. Discuss requirements with students.
2. Distribute white paper and colored pencils to students.
3. Have students begin the *Student Reflection* by sketching a draft. They will have additional time the following day to complete it.



Name _____ Date _____ Period _____

STUDENT REFLECTION

This will help you with in-depth understanding.

7.RP.A.2a Hot Sauce!

Instructions:

1. Draw a visual representation of the story. Include a title.
2. Create a mathematical representation (tables, graphs, equations, figures, etc.) that shows the math used in the story.
3. Write a brief narrative that describes how the math was used in the story. Use the vocabulary word(s) from the lesson.
4. Using an example from your life, create a multiple choice question using the math concept. Circle the correct answer.
5. Use the rubric to grade yourself by circling how you did in each category. Turn this in with your *Student Reflection*.

Vocabulary Word(s):

☐ Proportional relationship

General Example:

Rubric:

	4 Exceeds Expectations	3 Meets Expectations	2 Nearing Expectations	1 Does Not Meet Expectations	0 Incomplete
Visual Representation	My title and drawing clearly represent the story. I put extra effort into my work.	My title and drawing mostly represent the story. I put good effort into my work.	My title and drawing vaguely represent the story. I only put a little bit of effort into my work.	My title and drawing don't represent the story. I put very minimal effort into my work.	I didn't include a visual representation or title.
Mathematical Representation	My mathematical representation shows complete understanding of the math concept.	My mathematical representation shows basic understanding of the math concept.	My mathematical representation shows limited understanding of the math concept.	My mathematical representation shows little to no understanding of the math concept.	I didn't include a mathematical representation.
Math Story Narrative	I clearly described how the math is used in the story and used appropriate math vocabulary.	I described how the math is used in the story and used some math vocabulary.	I tried to describe how the math is used in the story and/or used limited math vocabulary.	I did not make it clear how the math is used in the story and/ or didn't use math vocabulary.	I didn't explain how the math is used in the story.
Multiple Choice Question	My multiple choice question is original and directly relates to the math concept. I have the correct answer.	My multiple choice question directly relates to the math concept. I have the correct answer.	My multiple choice question directly relates to the math concept, but I have the incorrect answer.	My multiple choice question doesn't use the math concept.	I didn't include a multiple choice question.

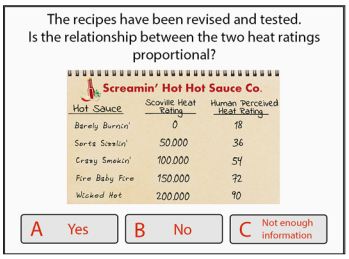
Test Trainer Pro

Allow 7 to 10 minutes

As a warm-up, tell students to log into their account and access *Test Trainer Pro*. Specify the domain in which you would like students to work (preferably a different one than the prior day) and also the length of time you wish students to work (not a number of items). It is important to remind students to work out the math using paper and pencil when necessary and to look at their feedback.

Clicker Quiz

Allow 30 minutes



Materials

- *Hot Sauce! Clicker Quiz*
- Student Devices
- Paper and Pencil

Procedure

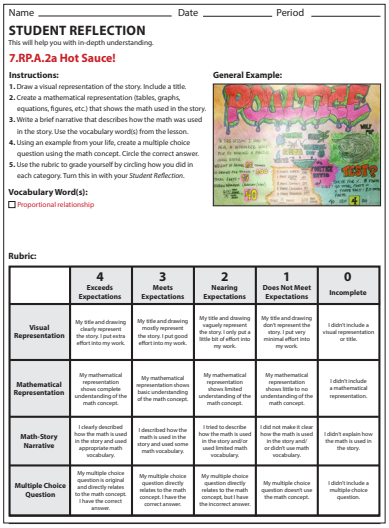
1. Ask students to log into their account and access *Virtual Clicker*.
2. Open the *Clicker Quiz*, whole class.
3. Prompt students to enter the quiz code on their device.
4. Launch quiz.
5. For each question:
    a. Show question and give students time to work. Consider using various protocols (i.e., students work individually, work with a partner, or maybe they have to agree with an entire table).
    b. Click "Vote," and students will have 10 seconds to enter a response.
    c. Analyze class distribution. Decide whether more teaching is necessary, either a mini-lesson from you or by having students share strategies.
    d. Click ">" to advance to the next question.
    e. You may either then "Skip" the question or repeat steps a through e.

Student Self-Assessment

- Refer to the instructions for the *Studenf Self-Assessment* (on a prior page of this lesson plan).
- Allow students time to assess their level of knowledge after having completed this component.
- Collect the self-assessment from students, or have them keep it for later components.

Student Reflection

Allow 20 minutes (optional)



Name _____ Date _____ Period _____

STUDENT REFLECTION

This will help you with in-depth understanding.

7.RP.A.2a Hot Sauce!

Instructions:

1. Draw a visual representation of the story. Include a title.
2. Create a mathematical representation (tables, graphs, equations, figures, etc.) that shows the math used in the story.
3. Write a brief narrative that describes how the math was used in the story. Use the vocabulary word(s) from the lesson.
4. Using an example from your life, create a multiple choice question using the math concept. Circle the correct answer.
5. Use the rubric to grade yourself by circling how you did in each category. Turn this in with your *Student Reflection*.

Vocabulary Word(s):

☐ Proportional relationship

General Example:

Rubric:

	4 Exceeds Expectations	3 Meets Expectations	2 Nearing Expectations	1 Does Not Meet Expectations	0 Incomplete
Visual Representation	My title and drawing clearly represent the story. I put extra effort into my work.	My title and drawing mostly represent the story. I put good effort into my work.	My title and drawing vaguely represent the story. I only put a little bit of effort into my work.	My title and drawing don't represent the story. I put very minimal effort into my work.	I didn't include a visual representation or title.
Mathematical Representation	My mathematical representation shows complete understanding of the math concept.	My mathematical representation shows basic understanding of the math concept.	My mathematical representation shows limited understanding of the math concept.	My mathematical representation shows little to no understanding of the math concept.	I didn't include a mathematical representation.
Math-Story Narrative	I clearly described how the math is used in the story and used appropriate math vocabulary.	I described how the math is used in the story and used some math vocabulary	I tried to describe how the math is used in the story and/or used limited math vocabulary.	I did not make it clear how the math is used in the story and/ or didn't use math vocabulary.	I didn't explain how the math is used in the story.
Multiple Choice Question	My multiple choice question is original and directly relates to the math concept. I have the correct answer.	My multiple choice question directly relates to the math concept. I have the correct answer.	My multiple choice question directly relates to the math concept, but I have the incorrect answer.	My multiple choice question doesn't use the math concept.	I didn't include a multiple choice question.

Materials

- *Student Reflections* from Day 3
- White Paper
- Colored Pencils
- Sticky Notes

Procedure

1. Students continue working and complete their *Student Reflections*.
2. Consider having a **Gallery Walk** when they are complete, using the **I Wonder…, I Notice…** protocol and sticky notes.

Gallery Walk (16-20 min)

Display student work (such as Student Reflections) on classroom walls. Assign groups with tasks focused on specific details (such as identifying different ways to solve a problem) and/or larger patterns (such as general misconceptions). Tell groups to walk around, complete their task (≈ 8-10 min), then prepare and report brief remarks to the class with their broader "a-ha" and "why" understandings (≈ 8-10 min).

I Wonder . . . , I Notice . . . (8-10 min)

Following a completed whole-class assignment, set ground rules for peer critique, including being thoughtful, specific, helpful and joining in (≈ 1 min)! Choose a student to be "the originator" who is tasked to explain his or her approach and solution to a problem (≈ 2 min), while other students listen only. Then ask other students to ask "the originator" clarifying questions or comments that start with 'I wonder' and 'I notice' (≈ 5-6 min).

Student Self-Assessment

- Refer to the instructions for the *Studenf Self-Assessment* (on a prior page of this lesson plan).
- Allow students time to assess their level of knowledge after having completed this component.
- Collect the self-assessment from students, or have them keep it for later components.

HOT SAUCE!

Artifact 1

Screamin' Hot Hot Sauce Co.

Hot Sauce	Scoville Heat Rating	Human Perceived Heat Rating
Carolina Green	0	0
Habañero Hazard	50,000	10
Blazing Burmese	100,000	25
Atomic Gold	150,000	45
Moroccan Face Melter	200,000	75

Name _____ Date _____ Period _____

HOT SAUCE!

Is Mr. Davis' perceived heat rating proportional to the Scoville heat rating?

After his first hot sauce taste test, professional taste-tester Wilbur Davis is now addicted to hot sauce! He can't get enough. He has again signed up with Screamin' Hot Hot Sauce Company to test the new sauces!

Marty and Jeanette, of the Screamin' Hot Hot Sauce Company, are still aiming for a proportional relationship between the human-perceived heat rating and the Scoville heat rating.

Use Marty's notes to determine if Mr. Davis' perceived heat rating is proportional to the Scoville heat rating, and explain your reasoning.

7.RP.A.2a

About this standard

Decide whether two quantities are in a proportional relationship, (e.g. by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin).

Screamin' Hot Hot Sauce Co.

Hot Sauce	Scoville Heat Rating	Human Perceived Heat Rating
Head Shakin'	0	0
Nose Scratchin'	50,000	24
Jaw Droppin'	100,000	48
Eye Poppin'	150,000	72
Face Meltin'	200,000	96

Name _____ Date _____ Period _____

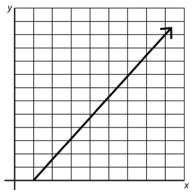
APPLYING THE STANDARD

How might this standard appear on a test?

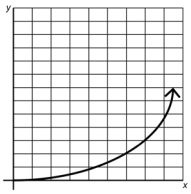
CHECK OUT MY WORKED EXAMPLE #1D

1) Look at each representation and determine whether y is proportional to x. Write either *proportional* or *not proportional*.

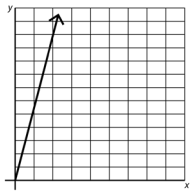
a)



b)



c)



d)

x	0	2	5	7	10
y	0	6	10	16	18

e) $1.5x = y$

f) $y = 5x + 2$

g) $y = 20x$

h)

x	1	3	4	6	12
y	8	24	32	48	96

2) The graph and the table each show a proportional relationship.

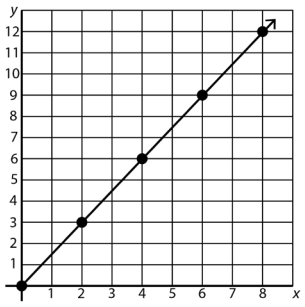
a)

x	y
0	0
2	58
5	145
7	203
15	435

Determine another ordered pair in this data set. Write the coordinates.

_____

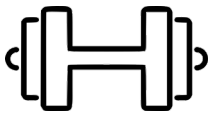
b)



Determine another point on the line. Write the coordinates.

_____

3) Workout World charges gym members $10 to sign up and then $20 every month. Good-To-Be-Fit charges their members $30 per month, with no sign-up fee.



a) For each company, complete the table showing the total amount paid over six months. Then write an equation that models the total cost (y) for any number of months (x).

Workout World Gym Costs

Number of Months	1	2	3	4	5	6
Total Cost ($)						

Good-To-Be-Fit Gym Costs

Number of Months	1	2	3	4	5	6
Total Cost ($)						

Equation: _____

Equation: _____

b) For which company is the total cost proportional to the number of months? How do you know?

Name: _____ **Lesson:** _____

Student Self-Assessment

	Don't get it, yet!	Working on it!	Almost there!	Got it!	Student Comments to Teacher
The Math Simulator					
Simulation Trainer					
Teacher Instruction					
Practice Printable					
Clicker Quiz					
Student Reflection					

Overall					

Don't get it, yet!	Working on it!	Almost there!	Got it!
I really didn't understand the math concepts at all. I don't really even know where to begin, yet. I will keep trying, but it would be helpful to get some support to get going.	I'm starting to understand the math concepts, at least a little bit. I still need some more time, and maybe a little bit of help to get to the next stage. Some things are a little bit confusing, and I'm not 100% sure of the main ideas yet.	Ok, I'm really starting to grasp the math concepts, but I did make an error or two. I mostly need to revise my work, and it might help me to have a little bit of help doing that just to double-check. In general, I'm starting to fully understand the math concept and after another attempt or two, I should have it.	I really know this math concept, and feel confident I could explain it to another person and very likely get it correct on the next attempt. Overall, I feel like 'I got it!'.

Name_____ **Lesson:** _____

Student Self-Assessment

Select Practice	Standards for Mathematical Practice	Don't get it, yet!	Working on it!	Almost there!	Got it!
☐	SMP 1 **Make sense of problems and persevere in solving them.**	It's difficult for me to stick with challenging problems if I don't get it the first time. I hesitate to try different strategies.	I stick with challenging problems and try more than once, but it's difficult for me to explain my thinking.	I stick with challenging problems and try more than once. I can explain one way to solve the problem.	I stick with challenging problems until I solve them. I look for multiple ways to explain my thinking or solve the problem.
☐	SMP 2 **Reason abstractly and quantitatively.**	It's difficult for me to create a representation of the problem. I don't know how to apply math symbols to solve problems.	I can create a representation of the problem, but I often lose track of the units or the meaning of my results along the way.	I can create a representation of the problem, but I sometimes lose track of the units or the meaning of my results along the way.	I can create a representation of the problem. I consider the units involved and keep track of the meaning of my results along the way.
☐	SMP 3 **Construct viable arguments and critique the reasoning of others.**	It's difficult for me to explain my own thinking and to understand the thinking of others.	I sometimes explain my own thinking but without accurate vocabulary, and rarely understand the solutions of others.	I often explain my thinking with accurate vocabulary, and can sometimes identify strengths and weaknesses of others' solutions.	I frequently explain my thinking with accurate vocabulary, and can often identify strengths and weaknesses of others' solutions.
☐	SMP 4 **Model with mathematics.**	It's difficult for me to represent problems and to develop a structure to solve them.	I identify important quantities in problems but have difficulty representing their relationships.	I use models and symbols to represent problem, and can explain the solution.	I use models and symbols to represent problem, can accurately explain the solution, and make sure my answer makes sense.
☐	SMP 5 **Use appropriate tools strategically.**	It's difficult for me to know when and how to use tools to help me solve a problem.	I sometimes use tools to explore and solve a problem but it's difficult to justify my choice.	I often use tools to explore and solve a problem and can justify my tool selection.	I frequently use tools to explore and solve a problem and can justify my tool selection.
☐	SMP 6 **Attend to precision.**	My calculations are often inaccurate, and it's difficult for me to communicate my thinking.	My calculations are sometimes inaccurate, and my communication is not always clear.	I calculate accurately and mostly use symbols, vocabulary, and labels to communicate my thinking.	I calculate accurately and always use symbols, vocabulary, and labels to communicate my thinking.
☐	SMP 7 **Look for and make use of structure.**	It's difficult for me to see patterns and structures in numbers and figures.	I sometimes see patterns and structures in numbers and figures, and can sometimes use them to solve problems.	I often see patterns and structures in numbers and figures, and can often use them to solve problems.	I see patterns and structures in numbers and figures, and can use them to solve problems.
☐	SMP 8 **Look for and express regularity in repeated reasoning.**	It's difficult for me to notice repeated calculations, and rarely find shortcuts.	I sometimes notice when calculations are repeated and might be able to find shortcuts to solve problems.	I notice when calculations are repeated and can often find shortcuts to solve problems.	I notice when calculations are repeated and can always find more efficient methods or shortcuts to solve problems.

Name _____ Date _____ Period _____

7.RP.A.2a ADDITIONAL PRACTICE

1) Are the ratios 3:5 and 10:15 equivalent?

2) Are these ratios equivalent?

8 cats to 12 dogs
12 cats to 15 dogs

3) Look at each table and determine whether *y* is proportional to *x*. Write either *proportional* or *not proportional*.

a)

x	*y*
0	2
2	4
4	6
6	8

b)

x	*y*
0	0
1	3
2	6
3	9

c)

x	*y*
3	3
5	5
7	7
9	9

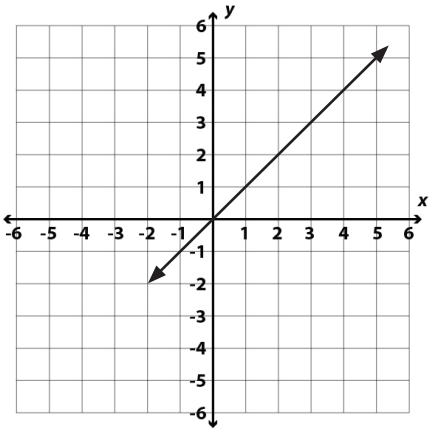
4) Look at each equation and determine whether *y* is proportional to *x*. Write either *proportional* or *not proportional*.

a) $y = 4x$

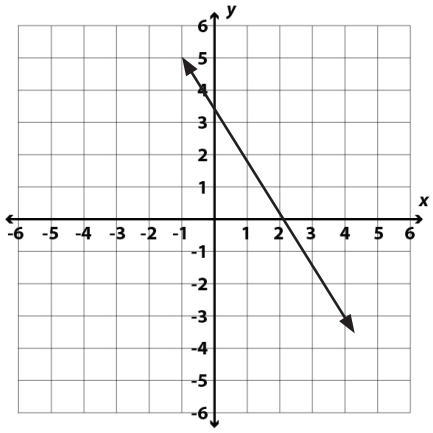
b) $-\frac{1}{4}x = y$

c) $y = 5x - 7$

5) Look at the graph and determine whether *y* is proportional to *x*. Write either *proportional* or *not proportional*.



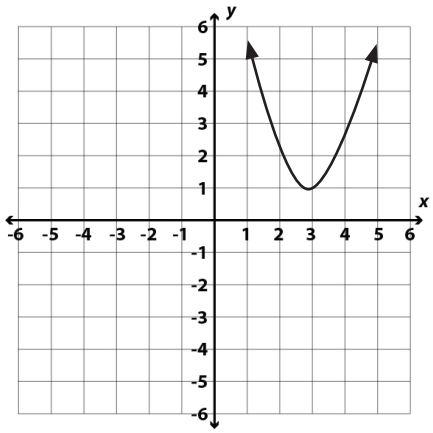
6) Look at the graph and determine whether *y* is proportional to *x*. Write either *proportional* or *not proportional*.



Name _____ Date _____ Period _____

7.RP.A.2a ADDITIONAL PRACTICE (cont'd)

7) Look at the graph and determine whether *y* is proportional to *x*. Write either *proportional* or *not proportional*.



8) The table shows a proportional relationship. Write another ordered pair in the dataset.

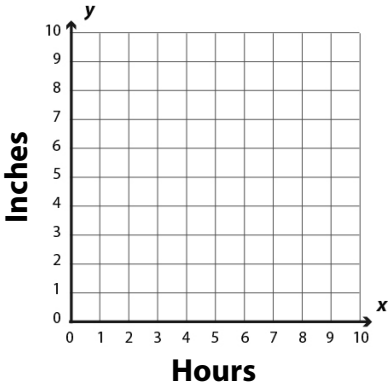
x	*y*
3	4
6	8
15	20
21	28

9) The table shows a proportional relationship. Write another ordered pair in the dataset.

x	*y*
3	1
9	3
27	9
30	10

10) In early February, Racine, WI was hit by a major snowstorm. Jared was excited and wanted to go sledding, so he kept track of the snow to make sure there was enough for sledding. After 2 hours, it had snowed 5 inches. He checked again after 6 hours, and it had snowed 8 inches.

Let *x* represent the amount of hours, and *y* represent the amount of snow that fell. Graph the two points and connect them with a line. Is this a proportional relationship?



Name _____ Date _____ Period _____

7.RP.A.2a ADDITIONAL PRACTICE

Answer Key

1) Are the ratios 3:5 and 10:15 equivalent?

No

2) Are these ratios equivalent?

8 cats to 12 dogs
12 cats to 15 dogs

No

3) Look at each table and determine whether *y* is proportional to *x*. Write either *proportional* or *not proportional*.

a)

x	*y*
0	2
2	4
4	6
6	8

b)

x	*y*
0	0
1	3
2	6
3	9

c)

x	*y*
3	3
5	5
7	7
9	9

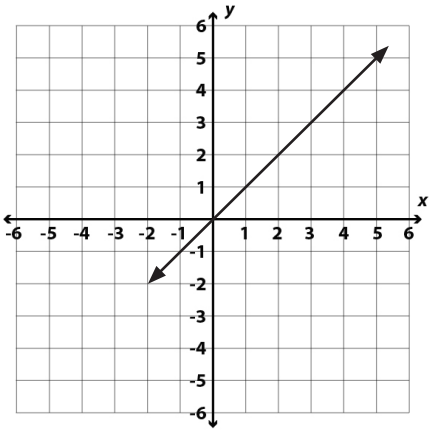
a) not proportional
b) proportional
c) proportional

4) Look at each equation and determine whether *y* is proportional to *x*. Write either *proportional* or *not proportional*.

a) $y = 4x$
b) $-\frac{1}{4}x = y$
c) $y = 5x - 7$

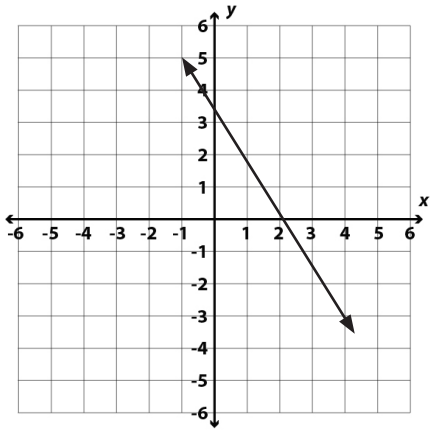
a) proportional
b) proportional
c) not proportional

5) Look at the graph and determine whether *y* is proportional to *x*. Write either *proportional* or *not proportional*.



Proportional

6) Look at the graph and determine whether *y* is proportional to *x*. Write either *proportional* or *not proportional*.

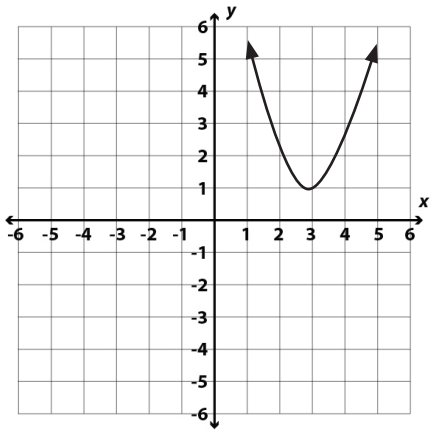


Not proportional

Name _____ Date _____ Period _____

7.RP.A.2a ADDITIONAL PRACTICE (cont'd) Answer Key

7) Look at the graph and determine whether *y* is proportional to *x*. Write either *proportional* or *not proportional*.



Not proportional

8) The table shows a proportional relationship. Write another ordered pair in the dataset.

x	*y*
3	4
6	8
15	20
21	28

Answers may vary.
Example answers might be:
(9, 12), (12, 16), (30, 40)

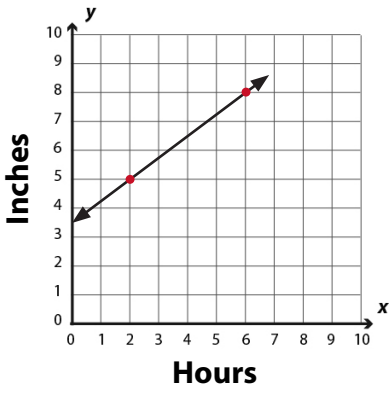
9) The table shows a proportional relationship. Write another ordered pair in the dataset.

x	*y*
3	1
9	3
27	9
30	10

Answers may vary.
Example answers might be:
(15, 5), (6, 2), (12, 4)

10) In early February, Racine, WI was hit by a major snowstorm. Jared was excited and wanted to go sledding, so he kept track of the snow to make sure there was enough for sledding. After 2 hours, it had snowed 5 inches. He checked again after 6 hours, and it had snowed 8 inches.

Let *x* represent the amount of hours, and *y* represent the amount of snow that fell. Graph the two points and connect them with a line. Is this a proportional relationship?



It is not a proportional relationship.