Do Now / Warm Up

Unit 2, Lesson 8 : Comparing Relationships w/ Equations

8.1 Warm Up:

1 min think, pair-share, whole class

Notice	Wonder
• width increases by 3 each time • height increases by 1 each time	• By how much does the area increase by each time? • By how much does the perimeter increase each time? • Which rectangle will have a width of 10?

NAME DATE PERIOD °C °F

8.2: More Conversions

Double number line

→ align the ticks at ∅

The other day you worked with converting meters, centimeters, and millimeters. Here are some more unit conversions.

When something is added to a proportional relationship in the form $y=kx$, then the relationship ceases to be proportional.

1.8

1. Use the equation $F = \frac{9}{5}C \boxed{+ 32}$, where F represents degrees Fahrenheit and C represents degrees Celsius, to complete the table.

x temperature (°C)	y temperature (°F)	k
20	68	3.4
4	39.2	9.8
175	347	1.98

2. Use the equation $c = 2.54n$, where c represents the length in centimeters and n represents the length in inches, to complete the table.

x length (in)	y length (cm)	k
10	25.4	2.54
8	20.32	2.54
$3\frac{1}{2}$ (3.5)	8.89	2.54

3. Are these proportional relationships? Explain why or why not.

°C ↔ °F The temperature conversion does not determine a proportional relationship because the number of degrees Fahrenheit per degree Celsius is not the same.

in ↔ cm The length conversion does determine a proportional relationship because the number of centimeters per inch is the same.

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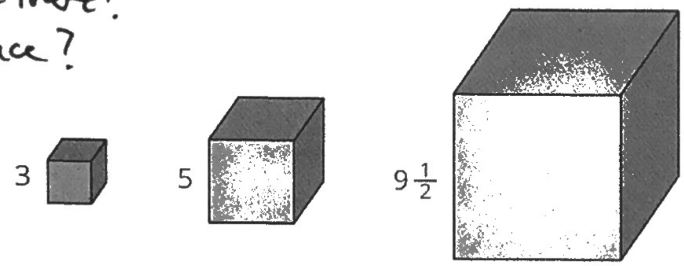
5 min quiet work, pair-share, whole class

Q1: How many edges are there?
Q2: How long is one edge?

8.3: Total Edge Length, Surface Area, and Volume

Here are some cubes with different side lengths. Complete each table. Be prepared to explain your reasoning.

Q3: How many faces are there?
Q4: How large is one face?



Don't spend as much time on S.A.

1. How long is the total edge length of each cube?

A1: A cube has 12 edges

side length (x)	total edge length (y)	k
3	36	12
5	60	12
$9\frac{1}{2}$	114	12
s	$12s$	12

if too hard, use $(x)10$, to yield $(y)120$

2. What is the surface area of each cube?

A3: A cube has 6 faces

A4: Each face has an area of s^2 sq. units.

side length (x)	surface area (y)	k
3	54	18
5	150	30
$9\frac{1}{2}$	$541\frac{1}{2}$	57
s	$6s^2$	$6s$

Don't spend as much time on volume.

3. What is the volume of each cube?

side length (x)	volume (y)	k
3	~~9~~ 27	9
5	~~25~~ 125	25
$9\frac{1}{2}$	$857\frac{3}{8}$	$90\frac{1}{4}$
s	s^3	s^2

4. Which of these relationships is proportional? Explain how you know.

The relationship between the side length & the total edge length is proportional. The quotients of second & first column are the same.

5. Write equations for the total edge length E, total surface area A, and volume V of a cube with side length s.

$E = 12s \rightarrow y = kx$

$A = 6s^2$

$V = s^3$

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Optional

Are you ready for more?

1. A rectangular solid has a square base with side length ℓ, height 8, and volume V. Is the relationship between ℓ and V a proportional relationship? No

2. A different rectangular solid has length ℓ, width 10, height 5, and volume V. Is the relationship between ℓ and V a proportional relationship? Yes

3. Why is the relationship between the side length and the volume proportional in one situation and not the other? In one situation, 2 unknown dimensions, and in the other only 1. Even though they look similar, the relationship is different.

Optional

8.4: All Kinds of Equations

5 mins. quiet work, pair-share, whole class

Here are six different equations.

$y = 4 + x$ ✗ $y = 4x$ ✓ $y = \frac{4}{x}$ ✗

$y = \frac{x}{4}$ ~~✗~~ ✓ $y = 4^x$ ✗ $y = x^4$ ✗

$y = \frac{1}{4}x$

1. Predict which of these equations represent a proportional relationship.

2. Complete each table using the equation that represents the relationship.

No
$y = 4 + x$

x	y	$\frac{y}{x}$
2	6	3
3	7	$2\frac{1}{3}$
4	8	2
5	9	$1\frac{4}{5}$ or 1.8

Yes
$y = 4x$

x	y	$\frac{y}{x}$
2	8	4
3	12	4
4	16	4
5	20	4

No
$y = \frac{4}{x}$

x	y	$\frac{y}{x}$
2	2	1
3	$\frac{4}{3}$	$\frac{4}{9}$
4	1	1/4
5	4/5	4/25

Yes
$y = \frac{x}{4}$

x	y	$\frac{y}{x}$
2	$\frac{1}{2}$	$\frac{1}{4}$
3	$\frac{3}{4}$	$\frac{1}{4}$
4	1	$\frac{1}{4}$
5	$\frac{5}{4}$	$\frac{1}{4}$

No
$y = 4^x$

x	y	$\frac{y}{x}$
2	16	8
3	64	$21\frac{1}{3}$
4	256	64
5	1,024	$204\frac{4}{5}$

No
$y = x^4$

x	y	$\frac{y}{x}$
2	16	8
3	81	27
4	256	64
5	625	125

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3. Do these results change your answer to the first question? Explain your reasoning.

(Responses vary)

4. What do the equations of the proportional relationships have in common?

- can be written $y = kx$
- do not contain any exponents or addition operations
- do not involve dividing by x

Lesson 8 Summary

If two quantities are in a proportional relationship, then their quotient is always the same. This table represents different values of a and b, two quantities that are in a proportional relationship.

a	b	$\frac{b}{a}$
20	100	5
3	15	5
11	55	5
1	5	5

Notice that the quotient of b and a is always 5. To write this as an equation, we could say $\frac{b}{a} = 5$. If this is true, then $b = 5a$. (This doesn't work if $a = 0$, but it works otherwise.)

If quantity y is proportional to quantity x, we will always see this pattern: $\frac{y}{x}$ will always have the same value. This value is the constant of proportionality, which we often refer to as k. We can represent this relationship with the equation $\frac{y}{x} = k$ (as long as x is not 0) or $y = kx$.

Note that if an equation cannot be written in this form, then it does not represent a proportional relationship.

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Unit 2, Lesson 9: Solving Problems about Proportional Relationships

Let's solve problems about proportional relationships.

9.1: What Do You Want to Know?

1 min quiet think, pair-share, whole class discussion

Consider the problem: A person is running a distance race at a constant rate. What time will they finish the race?

- How far did the person run in 1 min?
- What time did they start the race?

What information would you need to be able to solve the problem?

- How long is the race?
- How fast is the person running?

Q: What specific info. do you need?

Q: Why do you need that information?

9.2: Info Gap: Biking and Rain

Groups of 2

Your teacher will give you either a problem card or a data card. Do not show or read your card to your partner.

If

Card 1:

1. For Mai, $d = 250t$
   For Noah, $d = 300t$

2. Noah will arrive first, since it will only take him 30 mins ($9{,}000 \div 300 = 30$) while Mai takes 32 mins ($8{,}000 \div 250 = 32$)

d = distance in meters
t = time in mins

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Card 2:

1. $r = 0.4t$
   or $t = 2.5r$
   or $r = \frac{1}{150}t$
   or $t = 150r$

2. 12.5 or $12\frac{1}{2}$ hrs.

r = rainfall in cm
t = time in hrs.

card.

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4. After your partner solves the problem, ask them to explain their reasoning and listen to their explanation.

Pause here so your teacher can review your work. Ask your teacher for a new set of cards and repeat the activity, trading roles with your partner.

Share after a student specifically asks for it & explains why they need to know

9.1

Information About the Race

- The race is 10,000 meters long
- The race started at 9:15 am.
- In 1 min, the person ran $156\frac{1}{4}$ meters
- An equation relating distance and time is given by $d = 156\frac{1}{4} \cdot t$ where d represents the distance in meters & t represents time in mins.
- It takes 32 mins for the person to run 5,000 meters.
- The person runs at a pace of 6.4 mins / km (1,000 m)

→ After sharing a piece of info, ask if they have enough information to solve the problem each time. Then have solve.

Answer: The person should finish at 10:19 am.

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optional

9.3: Moderating Comments

A company is hiring people to read through all the comments posted on their website to make sure they are appropriate. Four people applied for the job and were given one day to show how quickly they could check comments.

B • Person 1 worked for 210 minutes and checked a total of 50,000 comments. 4 $\frac{50000}{210} \approx 238$ cpm

A • Person 2 worked for 200 minutes and checked 1,325 comments every 5 minutes. 3 $1325 \div 5 = 265$ cpm

$(1325 \div 5) \cdot 200 = 53,000$

D • Person 3 worked for 120 minutes, at a rate represented by $\underbrace{c = 331t}_{331 \text{ cpm}}$, where c represents the number of comments checked and t represents time in minutes. 1

$331 \cdot 120 = 39,720$

C • Person 4 worked for 150 minutes, at a rate represented by $t = \left(\frac{3}{800}\right) c$. 2 $800 \div 3 = 266\,2/3$ comments per min.

$\left(\frac{800}{3}\right) \cdot 150 = 40,000$

1. Order the people from greatest to least in terms of total number of comments checked.

   Least A, B, C, D Greatest

2. Order the people from greatest to least in terms of how fast they checked the comments.

   Greatest 1, 2, 3, 4 Least

Are you ready for more?

1. Write equations for each job applicant that allow you to easily decide who is working the fastest.
2. Make a table that allows you to easily compare how many comments the four job applicants can check.

Person	Equation	Time in mins	Total comments
1	$\frac{50000}{210} \approx 238.1$	210	50,000
2	$\frac{1325}{5} = 265$	~~15~~ 200	53,000
3	331	120	39,720
4	$\frac{800}{3} \approx 226.7$	150	40,000

Q: Which applicant should get the job? Why?

Person 3

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Lesson 9 Summary

Whenever we have a situation involving constant rates, we are likely to have a proportional relationship between quantities of interest.

- When a bird is flying at a constant speed, then there is a proportional relationship between the flying time and distance flown.
- If water is filling a tub at a constant rate, then there is a proportional relationship between the amount of water in the tub and the time the tub has been filling up.
- If an aardvark is eating termites at a constant rate, then there is proportional relationship between the number of termites the aardvark has eaten and the time since it started eating.

Sometimes we are presented with a situation, and it is not so clear whether a proportional relationship is a good model. How can we decide if a proportional relationship is a good representation of a particular situation?

- If you aren't sure where to start, look at the quotients of corresponding values. If they are not always the same, then the relationship is definitely not a proportional relationship.
- If you can see that there is a single value that we always multiply one quantity by to get the other quantity, it is definitely a proportional relationship.

After establishing that it is a proportional relationship, setting up an equation is often the most efficient way to solve problems related to the situation.