Developing Proportional Reasoning

By Brad Fulton
Educator of the Year
(Voted by the California League of Schools – 2005)
brad@tttpress.com

Teacher to Teacher Press
www.tttpress.com
PO Box 233, Millville, CA 96062
Phone: (530) 547-4687   Fax: (530) 547-4317

Join us!

Facebook: TeacherToTeacherPress

Twitter: @tttpress

YouTube

B r a d   F u l t o n

PO Box 233, Millville, CA 96062
(530) 547-4687
brad@tttpress.com

Brad Fulton

Educator of the Year

- ♦ **Consultant**
- ♦ **Educator**
- ♦ **Author**
- ♦ **Keynote presenter**
- ♦ **Teacher trainer**
- ♦ **Conference speaker**

Known throughout the country for motivating and engaging teachers and students, Brad has co-authored over a dozen books that provide easy-to-teach yet mathematically rich activities for busy teachers while teaching full time for over 30 years. In addition, he has co-authored over 40 teacher training manuals full of activities and ideas that help teachers who believe mathematics must be both meaningful and powerful.

Seminar leader and trainer of mathematics teachers

- ♦ 2005 California League of Middle Schools Educator of the Year
- ♦ California Math Council and NCTM national featured presenter
- ♦ Lead trainer for summer teacher training institutes
- ♦ Trainer/consultant for district, county, regional, and national workshops

Author and co-author of mathematics curriculum

- ♦ Simply Great Math Activities series: six books covering all major strands
- ♦ Angle On Geometry Program: over 400 pages of research-based geometry instruction
- ♦ Math Discoveries series: bringing math alive for students in middle schools
- ♦ Teacher training seminar materials handbooks for elementary, middle, and secondary school

Available for workshops, keynote addresses, and conferences

All workshops provide participants with complete, ready-to-use activities that require minimal preparation and give clear and specific directions. Participants also receive journal prompts, homework suggestions, and ideas for extensions and assessment.

Brad's math activities are the best I've seen in 38 years of teaching!
Wayne Dequer, 7th grade math teacher, Arcadia, CA

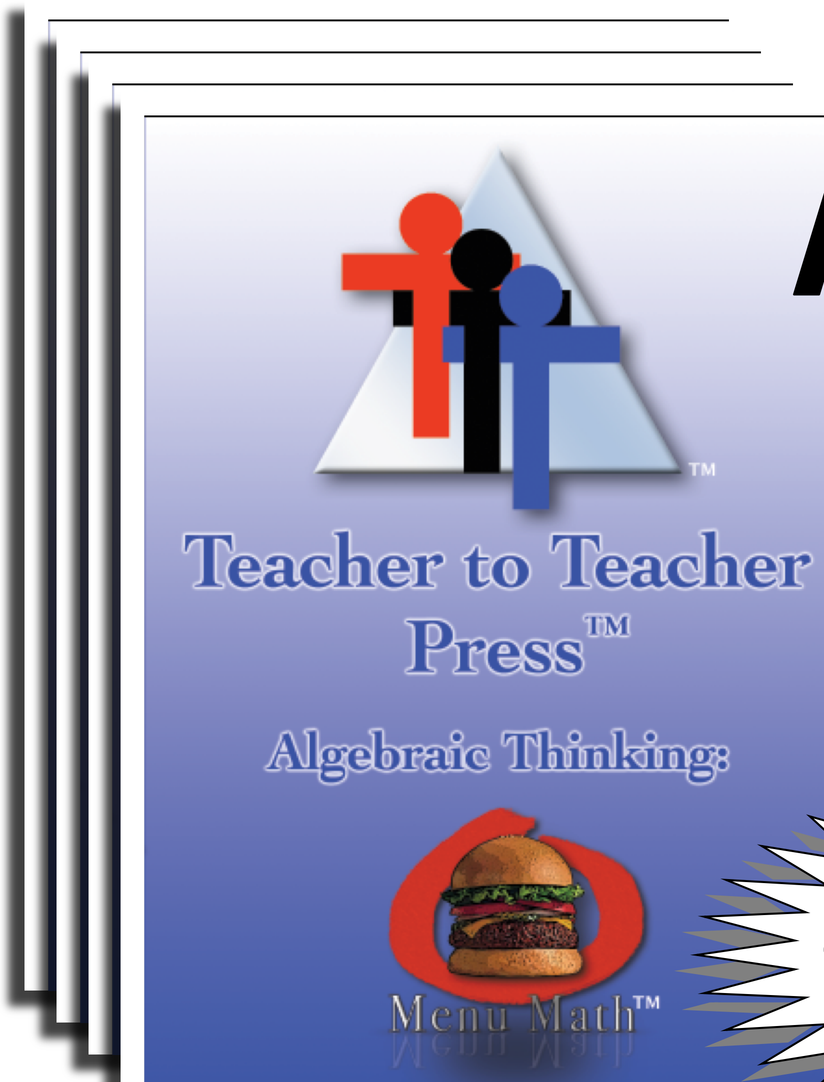
"I can't begin to tell you how much you have inspired me!"
Sue Bonesteel, Math Dept. Chair, Phoenix, AZ

"Your entire audience was fully involved in math!! When they chatted, they chatted math. Real thinking!"
Brenda McGaffigan, principal, Santa Ana, CA

"Absolutely engaging. I can teach algebra to second graders!"
Lisa Fellers, teacher

 www.tttpress.com

References available upon request



I want...

- a) effective staff development
- b) affordable staff development
- c) ongoing staff development

(pick three)

14 new DVD presentations offer quality mathematics staff development at a fraction of the cost!

er their multiplication facts and learn simple strategies for taming fractions.
rithmetic, number sense, algebra, and mathematical reasoning.
r fractions, decimals, and percents while developing reasoning skills.
students stay safer at home and school. Great for parents and staff
rategies to help your students find success with equations.
students learn the seamless way to tackle polynomials.
integrating number sense, operations, probability, and algebra.
teger operations with these classroom-tested strategies.
ual *Layering* to maximize mathematical skill and reasoning.
ering to help students transition from simple addition to algebra.
your students with an authentic assessment and teaching strategy that will

college have finally made sense of algebra with this clever approach.
d exponents, the zero power, and even *negative* exponents!
tions should be engaging, enriching, and empowering. Find out how to
this easy approach.

Proportional Reasoning

- ☑ Reinforces and embeds the concepts of proportions
- ☑ Helps students tackle word problems
- ☑ Easily converts fractions to percents
- ☑ Promotes multiple strategies for solving proportions
- ☑ Helps students discover the relationships among t-tables, graphs, and proportions.

There are significant differences between fractions and ratios. A fraction *always* compares a part to a whole. A ratio is not limited by this restriction, and therefore, the rules and algorithms that apply to fractions do not necessarily apply to ratios. For example, since we cannot divide by zero, and since a fraction is one way to represent a division problem, we never see zero in the denominator of a fraction. However, if we consider the ratio of my fingers compared to my wings, we get the fraction $^{10}/_{0}$, and this is perfectly acceptable.

Yet even when a ratio behaves like a fraction by comparing a part to a whole, we can see differences. An example will illustrate this problem.

Let's assume two basketball players are comparing their shooting. Player A makes 5 of 8 shots, while player B makes 3 of 5 shots. They combined to make 8 of 13 shots. Yet when we express the ratios of the two players and show them combined, we seem to have violated a critical algorithm for adding fractions:

$$\frac{5}{8}+\frac{3}{5}=\frac{8}{13}$$

It seems we have added fractions by simply adding numerators and adding denominators. The ratios are all correct though. The first ratio expresses the shots of player A, and the second ratio shows the shots of player B. The final ratio shows the combination of their work. The problem is that expressing the ratios as we did makes it appear that they should obey the rules for fraction addition, and in this case, that is not true. The best solution is to avoid expressing the ratios of this problem in this format.

This example illustrates the confusion ratios may present to a learner. It also shows why we can't tell students that ratios are simply fractions. What we have is a single representation for two different concepts. It would be like an addition sign meaning "add" in one context and "divide" in another one. In this situation, it would be better to express the ratios as 5 out of eight, 5 to eight, or 5:8.

There are multitudes of ways to explore, think about, and solve proportional situations. Nine of these will be presented in this paper.

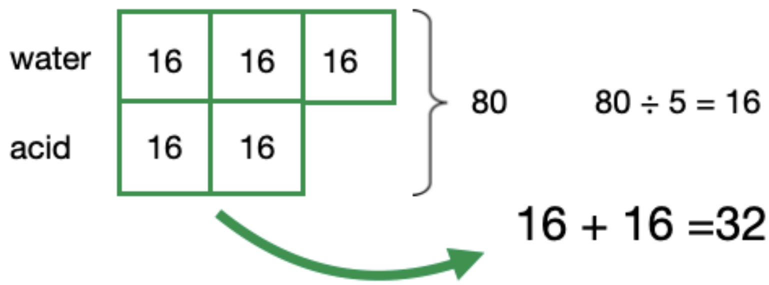
1. Tape diagrams
2. Factor of change
3. Unit rate
4. Fractional
5. Table
6. Graphical
7. Cross products
8. Factoring
9. Multiplication chart

Numbers 2 through 7 are described on the following pages in the activity called "Proportion Boxes." The other three are described below.

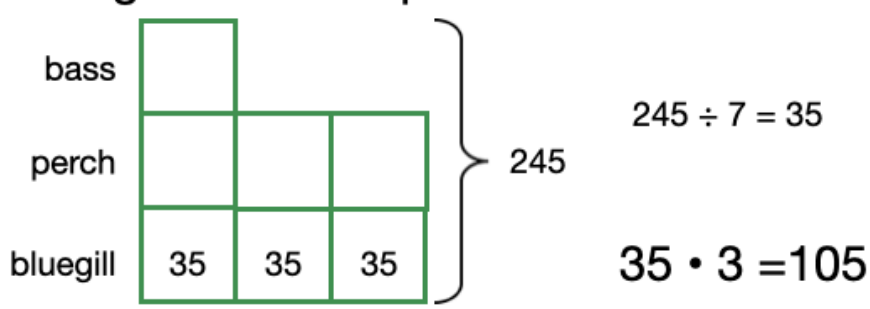
Some of these methods are more understandable while others are more abstract. However, some of the methods that are easier for students to understand apply to only a limited set of situations, while more abstract models apply to a wider variety of problems. You as the teacher will be the best judge of which methods are most appropriate for your classroom.

Tape diagrams are a very visual and conceptual approach to solving proportions and serve as a good starting place. Here are some sample problems.

The ratio of water to acid in a beaker is 3:2. There are 80 mL of liquid. How many mL of acid are in the beaker?



The ratio of bass to perch to bluegill in a pond is 1 to 3 to 3. There are 245 fish in the pond. How many bluegill are in the pond?

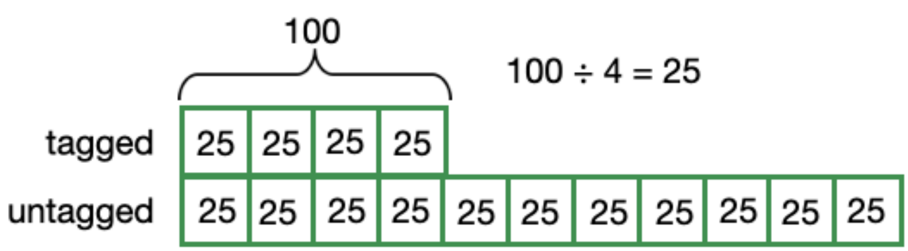


The ratio of Arturo's money to Brenda's is 7 to 2. Arturo has $84. If he pays her $36, what is the new ratio?

$84 \div 7 = 12$

The new ratio is 4:5

100 fish in a lake were caught and tagged. One month later, 15 fish were caught of which four had tags. How many fish are in the lake?

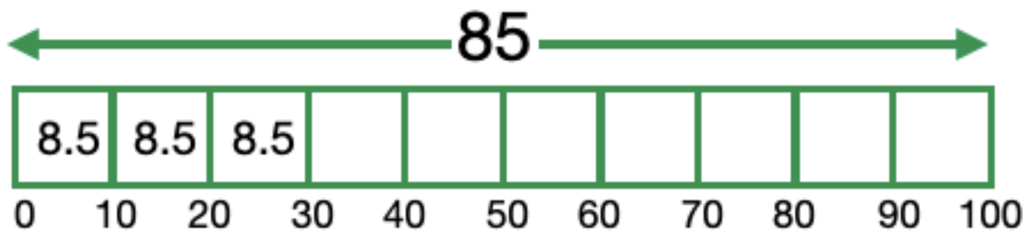


15 total fish

$25 \cdot 15 = 375$

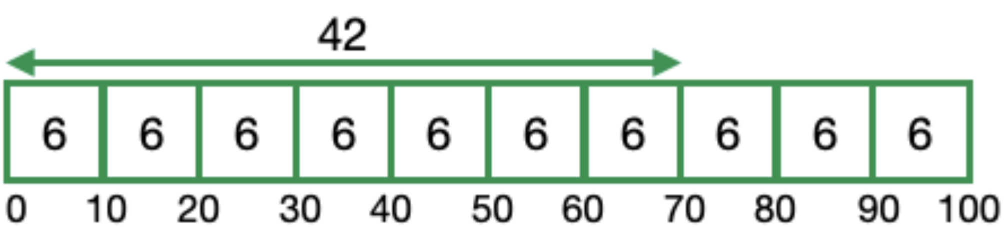
What is 30% of 85?

$85 \div 10 = 8.5$



$$8.5 \cdot 3 = 25.5$$

70% of what is 42?



$42 \div 7 = 6$

$$10 \cdot 6 = 60$$

Solving proportions by the factoring approach:
Let's solve the proportion shown below.

$$\frac{18}{24} = \frac{x}{28}$$

Write the terms in prime factorization:

$$\frac{(2)(3)(3)}{(2)(2)(2)(3)} = \frac{x}{(2)(2)(7)}$$

Now cancel common factors:

$$\frac{(\cancel{2})(3)(\cancel{3})}{(\cancel{2})(2)(2)(\cancel{3})} = \frac{x}{(2)(2)(7)}$$

Next match up horizontal pairs of factors:

$$\frac{(\cancel{2})(3)(\cancel{3})}{(\cancel{2})(2)(2)(\cancel{3})} = \frac{x}{(2)(2)(7)}$$

Notice that the only remaining factors are the 3 and the 7. Put these in place of the x and the proportion is solved.

$$x = (3)(7) = 21$$

Solving proportions using a multiplication chart:
Let's solve the proportion shown below.

$$\frac{6}{x} = \frac{15}{25}$$

Find a rectangle in the multiplication chart that has the three numbers in three corners as shown.

x	1	2	3	4	5
1	1	2	3	4	5
2	2	4	6	8	10
3	3	6	9	12	15
4	4	8	12	16	20
5	5	***10***	15	20	25

Look what shows up in the fourth corner–the answer to our proportion!

"Building Mathematical Skill on a Foundation of

Teacher to Teacher Press Newsletter

Volume 304 April, 2003

Proportion Boxes

The development of proportional reasoning is critical for intermediate and middle school learners. That is why we must provide many opportunities for students to apply and practice these skills. We also can help students by demonstrating numerous ways to solve ratios by filling their toolkit with a multitude of strategies.

Procedure:

Required Materials:
☒ Paper
Optional Materials:
☐ Transparency of Activity Master

1 There are at least six approaches to introducing ratios. Each will be explained briefly here, and then an approach for teaching word problems involving ratios will be shown.

2 Most students find the **factor of change** method the simplest place to start. This involves multiplying one ratio to get a second one. Consider the following problem:
Four widgets sell for six dollars. How much will 12 widgets cost?

It is easy to see that since 12 widgets are three times as many as six widgets, the cost will also be three times as much, or $18, as shown here.

x 3

$$\frac{4}{6} = \frac{12}{x}$$

x 3

3 The factor of change method works well until the factor is no longer a whole number. If we are trying to determine the cost of 10 widgets, other methods may seem easier. One is the **unit rate** method. In this, the unit price is established. For example, if four widgets sell for six dollars, dividing six by four shows that each unit sells for $1.50. Once this unit rate is found, it can be used as a multiplier in the second ratio as shown.

$$\frac{6}{4} = \frac{1.5}{1} \qquad \text{x 1.5} \quad \frac{6}{4} = \frac{x}{10} \quad \text{x 1.5}$$

x 5

$$\frac{4}{6} = \frac{2}{3} \qquad \frac{2}{3} = \frac{10}{x}$$

x 20

4 A third method involves seeing the ratio as a **fraction**. In the last example, we could simplify the first ratio. The new ratio would allow us to apply the factor of change method. This method can often be applied to percent problems. If we want to

x 5

$$\frac{60}{75} = \frac{4}{5} \qquad \frac{4}{5} = \frac{x}{10}$$

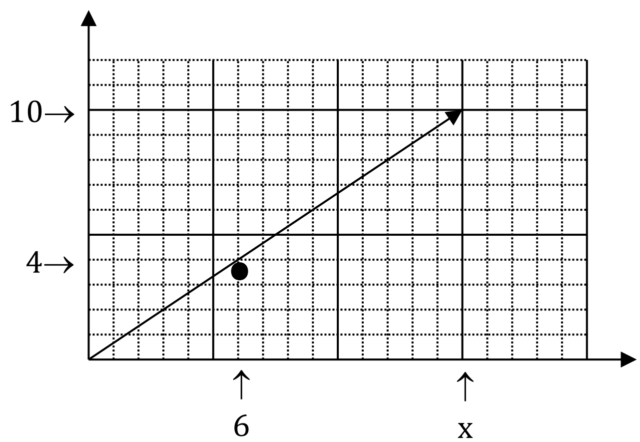
x 20

know the percent for 60 out of 75, we can simplify the fraction first, then find a factor of change to make the denominator equal to 100.

5 In the fourth method, a **table** is constructed showing the initial ratio and multiples of it. Eventually this can lead us to determine a value for the second ratio as shown on the next page.

6 Another method uses a **graph** to solve the ratio. The initial ratio is graphed as a coordinate pair. A line is extended through this point from the origin. Next the second ratio is located on this line by finding the known part of the coordinate. In the previous example, the numerator, 10, is located on the vertical axis. This corresponds to a value of 15 on the horizontal or denominator's axis as shown. In fact, a graph provides a good visual definition of a proportion. When graphed, all proportions are straight lines, passing through the origin, and sloping up to the right. Any other graph is not a proportion.

	x	y	
	4	6	
	8	12	
10→			←x
	12	18	



7 The sixth method is to use **cross products**. Here the ratio is solved algebraically by multiplying diagonally. The advantage of this method is that it works universally.

$$\frac{4}{6} = \frac{10}{x} \qquad 4x = 60 \qquad x = 15$$

8 Now let's look at a way to analyze troublesome word problems. Keep in mind that a proportion compares two data pairs. In the previous example we are comparing the **quantity**

	small	large
quantity		
cost		

and cost of widgets in a **small and a large** sample. Have the students make a sketch of the grid shown on the right. Label it as shown.

9 Next the students should fill in the known data and write an "x" in the fourth cell. Notice that this places the data in the form of a proportion.

$$\frac{4}{6} = \frac{10}{x}$$

	small	large
quantity	4	10
cost	6	x

Using cross products produces 4x = 60 as before. It even works if the labels are switched as shown on the bottom right. This produces a new proportion, but the cross products are the same.

$$\frac{x}{10} = \frac{6}{4} \qquad 4x = 60 \qquad x = 15$$

	large	small
cost	x	6
quantity	10	4

10 These ratio boxes are an excellent way to solve the three types of proportions involving percents. These three situations are shown here.

What percent is three out of five?

$$\frac{3}{5} = \frac{x}{10}$$

	fractio	percen
part	3	x
whole	5	100

What is 80% of 25?

$$\frac{x}{25} = \frac{80}{10}$$

	fractio	percen
part	x	80
whole	25	100

15% of some number is 6. What is the number?

	fractio	percen
part	6	15
whole	x	100

$$\frac{6}{x} = \frac{15}{10}$$

11 All percent problems can be solved using this ratio box and its four labels. Most other proportions involve a small and large sample. Many will use the labels “part” and “whole”. Other common labels may include conversions from one unit to another, such as inches to centimeters or dollars to pesos.

These ratio boxes will help your students process the information in word problems and organize it so they will be successful in solving the proportion. **Check out next month’s newsletter for a great problem that will allow your children an opportunity to use these skills in a challenging exploration.**

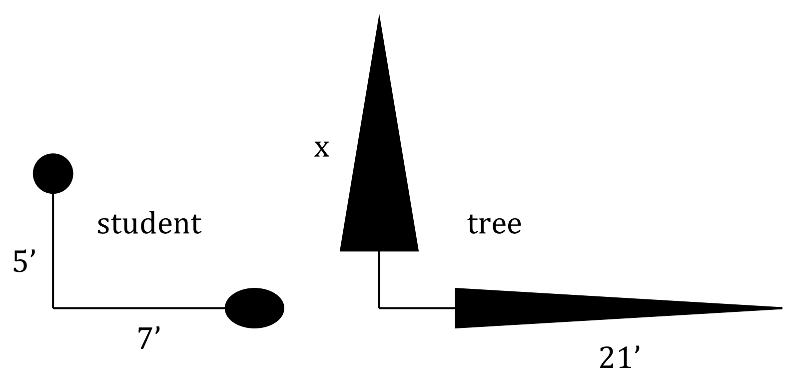
We always love to hear from our readers. Email us with your comments on this activity at either

brad@tttpress.com or **bill@tttpress.com**

Good Tip:

On a sunny day, take students outside to measure the heights of inaccessible objects by comparing the shadow lengths of the object to their own as shown here.

	studen	tree
height	5’	x
shadow	7’	21’



What percent is 8 out of 25?

	fraction	percent
part	8	?
whole	25	100

Transparency Master 2

What is 40% of 20?

	fraction	percent
part	?	40
whole	20	100

75% of some number is 15. What is the number?

	fraction	percent
part	15	75
whole	?	100

"When are we ever gonna use this?" is often asked in math classes, but when it comes to ratios and proportional reasoning, this should be an easy question to answer, as these concepts are frequently used in our daily lives.
If we drove 120 miles in two hours, how long will it take to drive to Sacramento? If we used four gallons of gas for that portion of the trip, how much gas will we use altogether? And if those two gallons of gas cost $6.28, how much will the trip cost?
If we earned $27 in three hours, how much will we earn in a 40-hour week? If taxes take 28% of each dollar, how much will I owe in taxes? How many of my 40 hours are spent earning money that pays taxes.
If my cell phone carrier charged me $5.76 for 72 text messages, how many can I send and stay under $5.00 for the month? How much will I spend on text messages in a year?
A very hands-on activity for using proportions involves measuring the heights of tall objects by measuring their shadows. On a sunny day, measure the height of a student of other reachable object and measure its shadow. Measure these in meters. Then measure the shadow of some tall objects such as a tree or gymnasium. This data can then be put into a proportion box as shown here:

	person	object
height	1.47	x
shadow	2.38	19.11

This can then be solve algebraically using cross products:

$$(1.47)(19.11) = 2.38x$$
$$\frac{(1.47)(19.11)}{2.38} = x$$
$$x \approx 11.80$$

Students enjoy getting outdoors and using mathematics to explore their world. They also see that mathematics is an empowering tool that gives them the ability to literally reach new heights.

"Building Mathematical Skill on a Foundation of Understanding"

Teacher to Teacher Press Newsletter

Volume 305 May, 2003

Lemons and Grapefruits

As our plane leaves San Antonio and the 81st annual NCTM conference, we put the finishing touches on May's newsletter. We were pleased to meet so many of you at our presentations and strolling along the meandering San Antonio River. We see that the mathematical community is a tightly woven fabric of teachers working together to support one another for the sake of our students. With this in mind, we offer you an intriguing activity to follow up last month's newsletter on teaching ratios. This problem will not only promot the diversity of thinking in your classroom, but the solutions we offer are just as unique.

Required Materials:
- ☒ Activity Master
- ☒ Super Citrus Solution

Optional Materials:
- ☐ Transparency of Answer Key

Procedure:

1 Give each student a copy of the Activity Master and explain the problem. As an example, ask them how many lemons can be shipped in a crate that contains 9 grapefruit. Though the problem is simple enough, the solution is challenging for students. If they have learned to solve proportions they may approach the problem this way:

$$\begin{array}{r} \text{Grapefruit} \\ \text{Lemons} \end{array} \frac{12}{20} = \frac{9}{x} \qquad 12x = 180$$

They might think this suggests that 15 lemons can be put in the case. However this solution cannot be possible since that puts a total of 24 mixed fruit in a box that can hold only 20 lemons at the most. Although the problem can be solved using proportions, it is worth exploring first using other means.

G	L
0	20
1	
2	
3	15
4	
5	

2 Ask the students to use the first t-table to explore possible combinations. Are there any combinations of grapefruit and lemon we know will fit in the box? In fact there are two obvious ones: 12 grapefruit with zero lemons and 20 lemons with zero grapefruit. Once these two solutions are put on the t-table, a third solution begins to become apparent. You could fill half the box with grapefruit (6) and the other half with lemons (10). Midway between these solutions, we have a box that is one-quarter grapefruit (3) and three-fourths lemons (15). There is also a solution that fills the box three-fourths full of grapefruit (9) and one-fourth full of lemons (5). These combinations are shown in the t-table.

G	L
0	20
1	$18^1/_3 \approx 18$
2	$16^2/_3 \approx 16$
3	15
4	$13^1/_3 \approx 13$
5	$11^2/_3 \approx 11$
6	10
7	$8^1/_3 \approx 8$
8	$6^2/_3 \approx 6$
9	5
10	$3^1/_3 \approx 3$
11	$1^2/_3 \approx 1$
12	0

3 Students may now notice the unit rate for this ratio. As the number of grapefruits increases from zero to three, the number of lemons goes down

five. This is true throughout the table. That is, three grapefruit equal five lemons. Thus one grapefruit is equal to $^5/_3$ or $1^2/_3$ lemons.

$$\begin{array}{r} \text{Grapefruit} \\ \text{Lemons} \end{array} \quad \frac{3}{5} = \frac{1}{x} \qquad 3x = 5$$

4 Now we know how many lemons to deduct for each grapefruit added to the case. We must keep in mind though that when dealing with a fraction of a lemon the answer should be rounded down to the nearest whole number. The company would never ship a fraction of a lemon, nor would they try to overstuff a box and smash the fruit. In reality the remaining space would be filled with packing material. This results in the table shown here.

5 It seems that this table solves the problem. However this chart is dependent upon a customer ordering a specific number of grapefruit. But what if the customer orders twelve lemons? This is not shown in the table. For this situation, we need a second t-table that converts lemons to grapefruit. The same processes can be used to make this table as we used in the previous one. The unit rate is now 1 lemon = $^3/_5$ grapefruit. The table is shown below to the right. Notice that in both tables there is a pattern to the numbers of the rounded data.

6 Another approach is to graph the problem. For this purpose we will consider the graph of the first t-table. If we graph the first point, (0, 20), and last point, (12, 0), on the table and connect them with a straight line, the line also passes through the points (3, 15), (6, 10), and (9, 5). The points that have been rounded off can also be shown on the graph, but they will not be on the line; they will be below it. On the answer key, these points have been connected with a dotted line and the area between it and the solid line has been shaded. You might consider the graph the following way. The solid line represents what the box is capable of holding. The dotted line represents the fruit that can actually be placed in the crate, and the shaded area represents packing material. The graph is a wonderful representation of the real-world aspects of the problem.

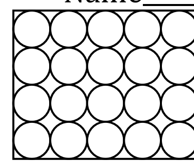
7 An even more visual approach to the problem is the Super Citrus Solution. Here a model of the 12 grapefruit and 20 lemons has been scaled so they are the same lengths. You might think of the space between the two dotted lines as a long box that can hold the 12 grapefruit, the 20 lemons, or any combination of the two. By sliding the joined strips between the dotted slits, students can see the different combinations that are possible.

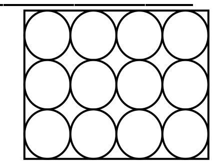
Lastly, we can use proportions to solve the problem. If we consider the original problem posed in step one, it seems to suggest an impossible solution of 9 grapefruit and 15 lemons. However, what the problem tells us is that the 9 grapefruit *are equivalent to* 15 lemons. This means there is only room for five more lemons. This type of proportion is called an *inverse proportion*. This is demonstrated by the fact that the graph slopes downward instead of upward. Although this is a perfectly appropriate way to solve the problem, it is the least visual of the methods and should be saved for last.

L	G
0	12
1	$11^2/_5 \approx 11$
2	$10^4/_5 \approx 10$
3	$10^1/_5 \approx 10$
4	$9^3/_5 \approx 9$
5	9
6	$8^2/_5 \approx 8$
7	$7^4/_5 \approx 7$
8	$7^1/_5 \approx 7$
9	$6^3/_5 \approx 6$
10	6
11	$5^2/_5 \approx 5$
12	$4^4/_5 \approx 4$
13	$4^1/_5 \approx 4$
14	$3^3/_5 \approx 3$
15	3
16	$2^2/_5 \approx 2$
17	$1^4/_5 \approx 1$
18	$1^1/_5 \approx 1$
19	$^3/_5 \approx 0$
20	0

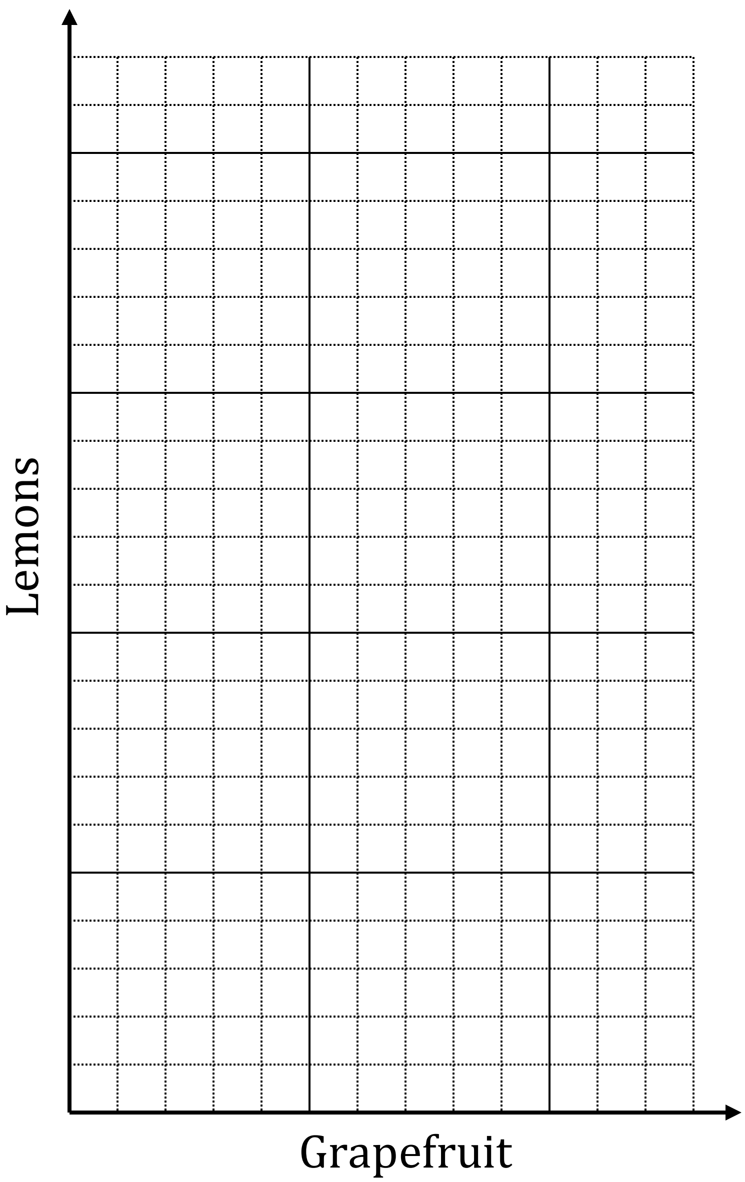
Activity Master

Name____________________





The Sunshine Citrus Company sells cases of lemons or grapefruits. Each case holds 20 lemons or 12 grapefruit. To increase sales, the company decides to ship cases of mixed fruit. They have hired you to help them decide how many of each type of fruit can be shipped in a case.



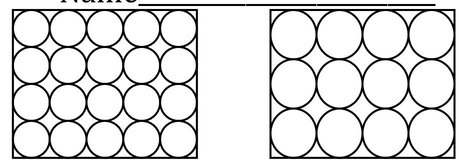
G	L
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

L	G
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

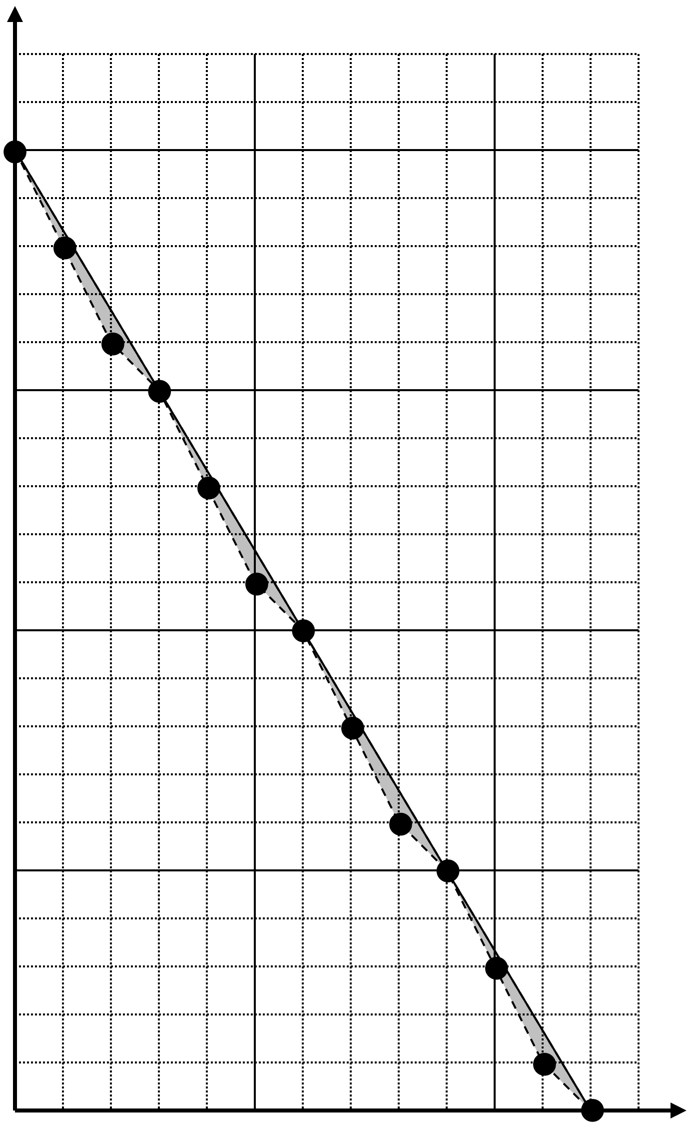
 www.tttpress.com

Answer Key

Name____________________



The Sunshine Citrus Company sells cases of lemons or grapefruits. Each case holds 20 lemons or 12 grapefruit. To increase sales, the company decides to ship cases of mixed fruit. They have hired you to help them decide how many of each type of fruit can be shipped in a case.

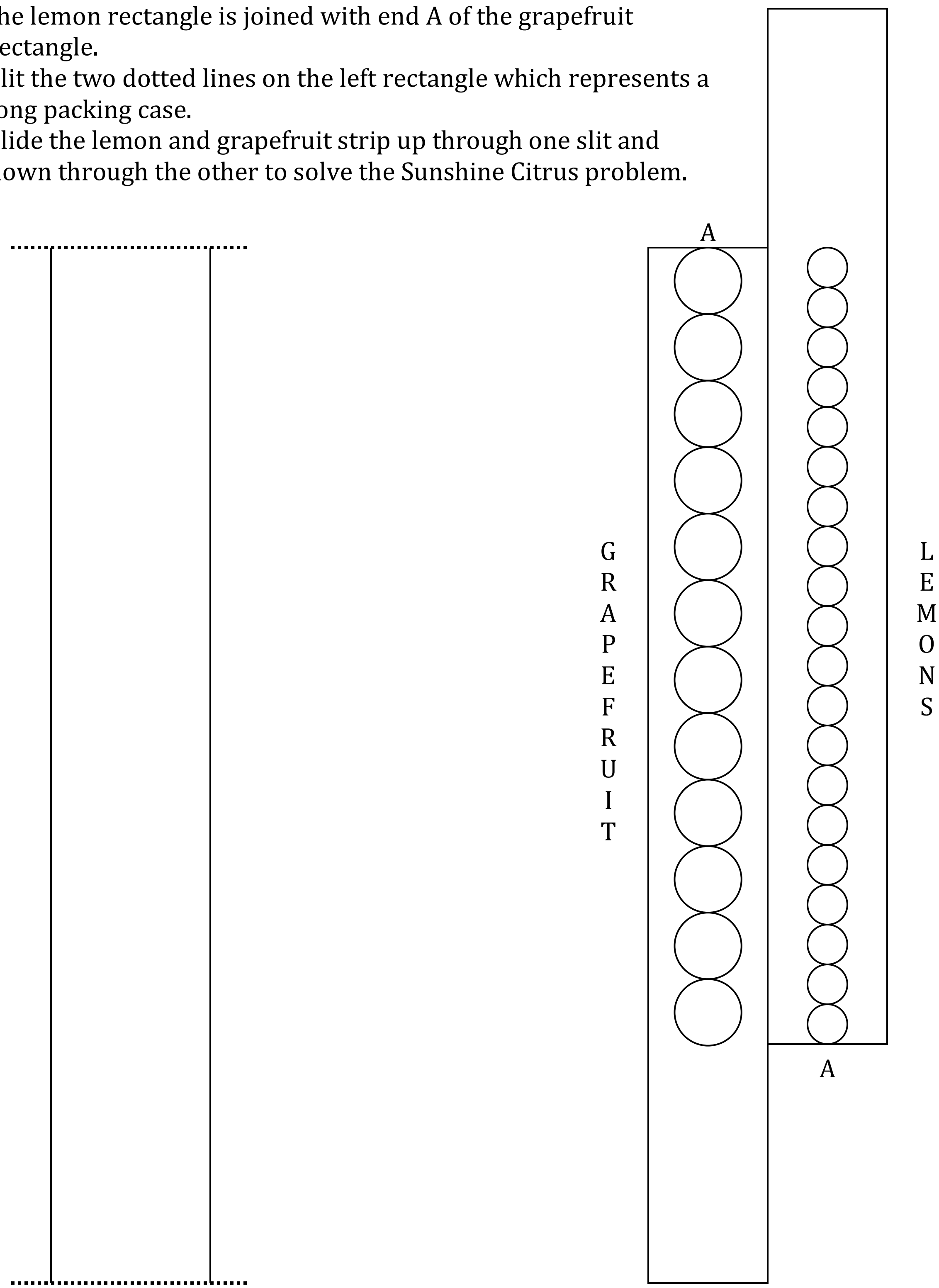


G	L
0	**20**
1	18
2	16
3	**15**
4	13
5	11
6	**10**
7	8
8	6
9	**5**
10	3
11	1
12	**0**

L	G
0	**12**
1	11
2	10
3	10
4	9
5	**9**
6	8
7	7
8	7
9	6
10	**6**
11	5
12	4
13	4
14	3
15	**3**
16	2
17	1
18	1
19	0
20	**0**

The Super Citrus Solution

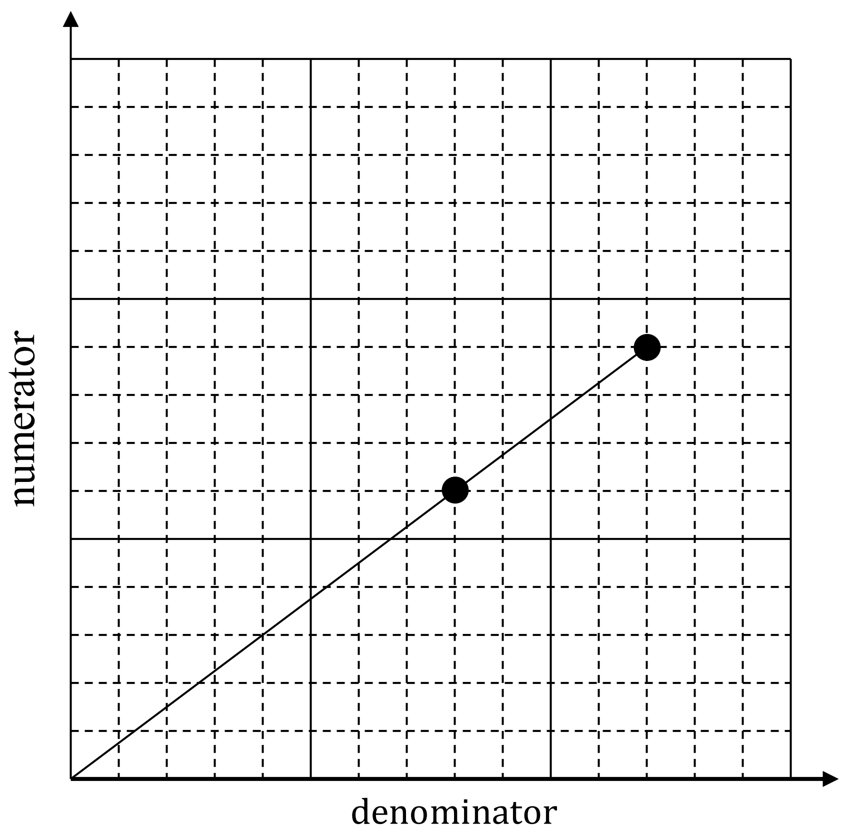
1 Color the lemons yellow and the grapefruit pink.
2 Cut out the two rectangles and tape them together so end A of the lemon rectangle is joined with end A of the grapefruit rectangle.
3 Slit the two dotted lines on the left rectangle which represents a long packing case.
4 Slide the lemon and grapefruit strip up through one slit and down through the other to solve the Sunshine Citrus problem.



What is a proportion? The answer to this question can be somewhat technical. While a proportion can be defined simply as an equality of two ratios, how can we tell which of the following are proportions and which are not?

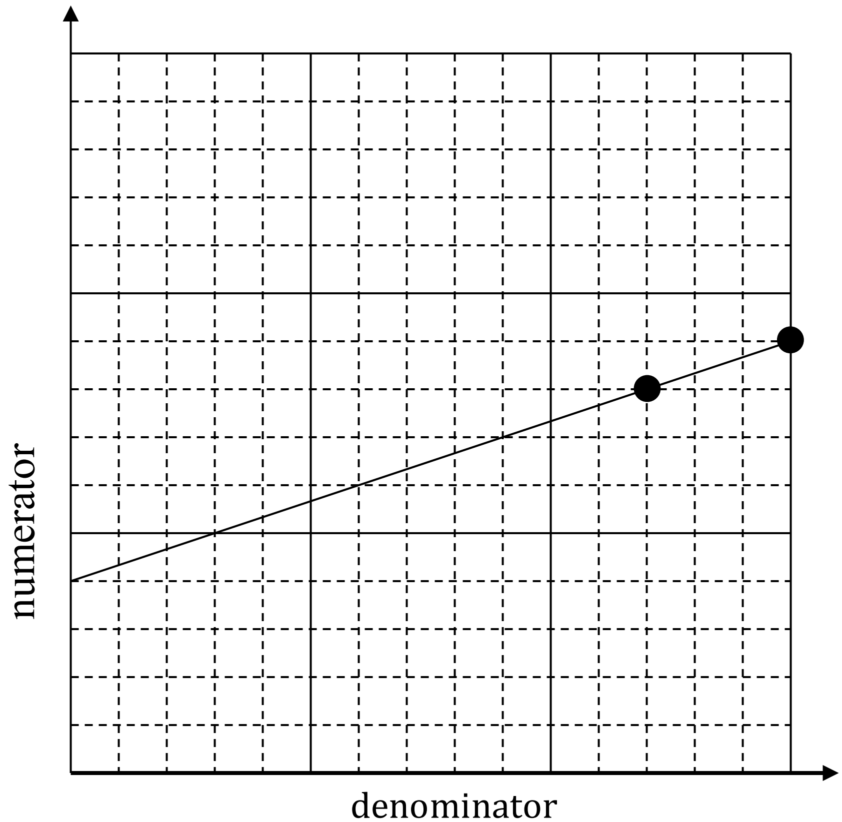
$$\frac{8}{18} = \frac{20}{45} \qquad \frac{9}{15} = \frac{8}{12} \qquad \frac{6}{8} = \frac{9}{12}$$

One way is by comparing cross products. Proportions have equal cross products. While this is a reliable method, it relies on a student's ability to multiply numbers correctly…twice. A graph however offers us a visual way to identify what is a proportion and what is not.
Let's graph the third proportion by plotting the denominator on a horizontal axis, and the numerator on the vertical axis. When we do this to both of the ratios in the example, we see that a line passing through them will also pass through the origin. *This is true for all proportions.*



Proportional ratios

However, When we try this for the second example, we see that the two ratio points are not contiguous with the origin, proving that they are not proportional.



Nonproportional ratios

A Day in My Life Project

Introduction:
Students will use proportions to analyze how they have spent their lives. This lesson is an extension of the proportional reasoning workshop offered by Brad Fulton. Students will utilize the "proportion boxes" approach introduced in that presentation. They will use proportions to convert hours into years, degrees, and a circle. They will represent their data in a pie graph. They will also practice measurement in standard units and can work with compasses and protractors.

Materials
- ✓ 11" by 17" paper
- ✓ rulers
- ✓ protractors
- ✓ compasses
- ✓ colored pencils or crayons

Preparation:
1. Have the students list five activities they do during a typical day that do not overlap. For example, two of their choices might be school and sleeping. Being at home and sleeping would not be good choices since they happen concurrently.
2. Ask them to estimate the number of hours they spend at each activity. Fifteen minutes would be written as .25 hours.
3. Their sixth region would be other and needs to account for all the remaining hours in a day.
4. Have them convert their hours per day into years of their total life using proportion boxes.
5. They can check their work by adding the hours to see if it equals 24 and adding the years to see that it equals their age.

Design:
Use the accompanying masters or have students design the project on blank 11" by 17" paper.
1. The paper will need to be laid out horizontally in "landscape" mode.
2. Have the student divide the paper vertically down the center by folding or by measuring.
3. The proportion boxes have a 1" border around the outside. Each square measures 1" on the side.
4. The pie chart measures 6" in diameter and is raised 1½" from the bottom edge of the paper. The tick marks are located every 5º.
5. Students will calculate the degree measure of the pie sectors using proportion boxes.
6. They will also use proportion boxes to calculate the percents.

7. Lettering and labels should be neat. The title should be centered on the side with the pie chart.
8. The colors of the pie regions should match the corresponding proportion boxes.

To convert hours to years:

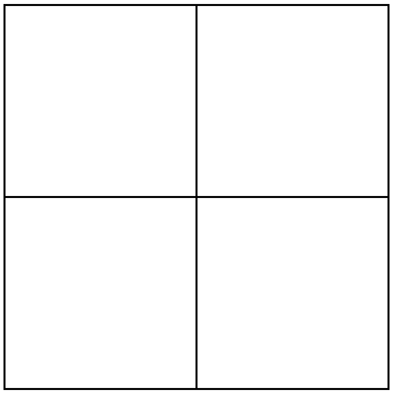
	Hours	Years
Part	6	x
Whole	24	13

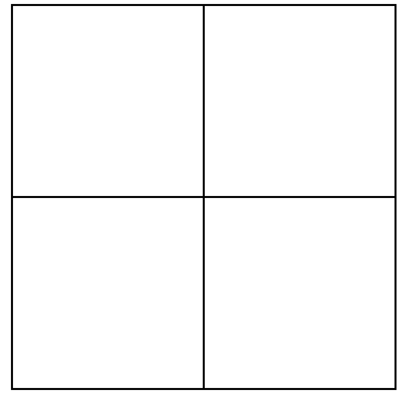
To convert hours to degrees:

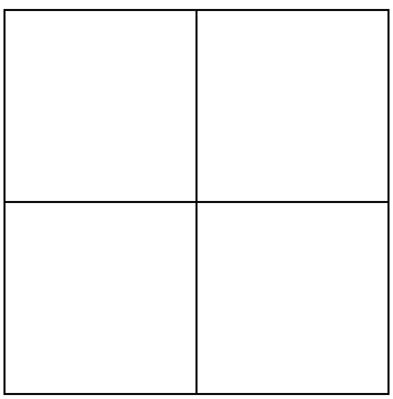
	Hours	Years
Part	6	x
Whole	24	360

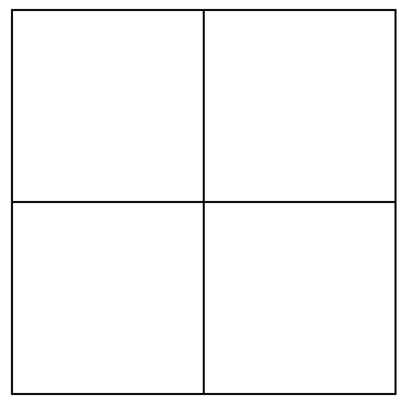
To convert hours to percents:

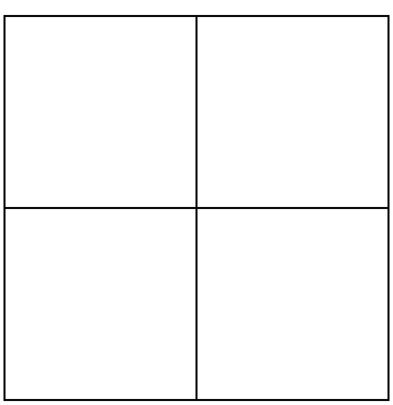
	Hours	Years
Part	6	x
Whole	24	100

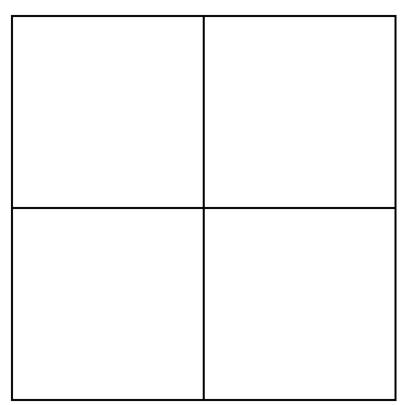


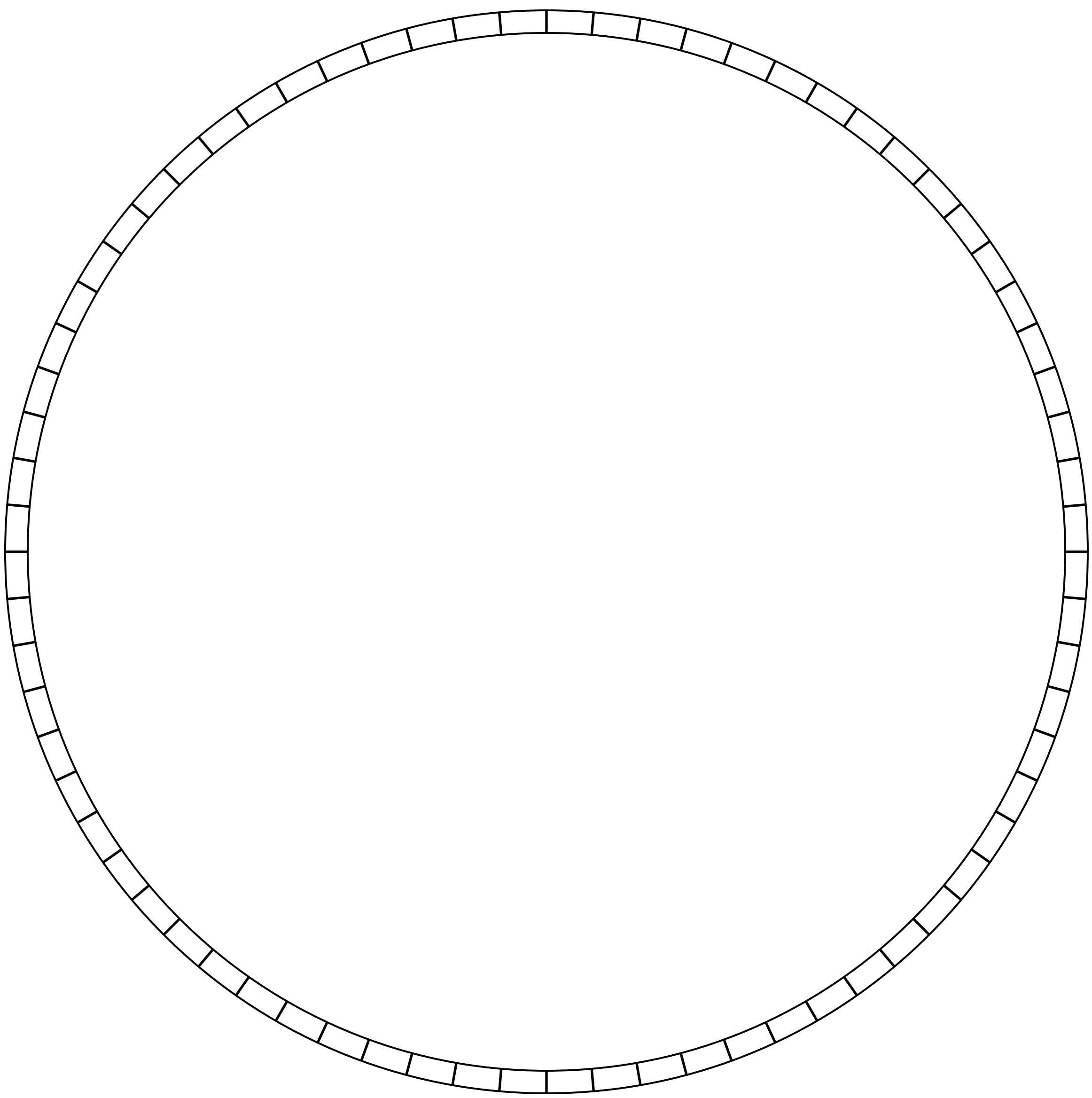


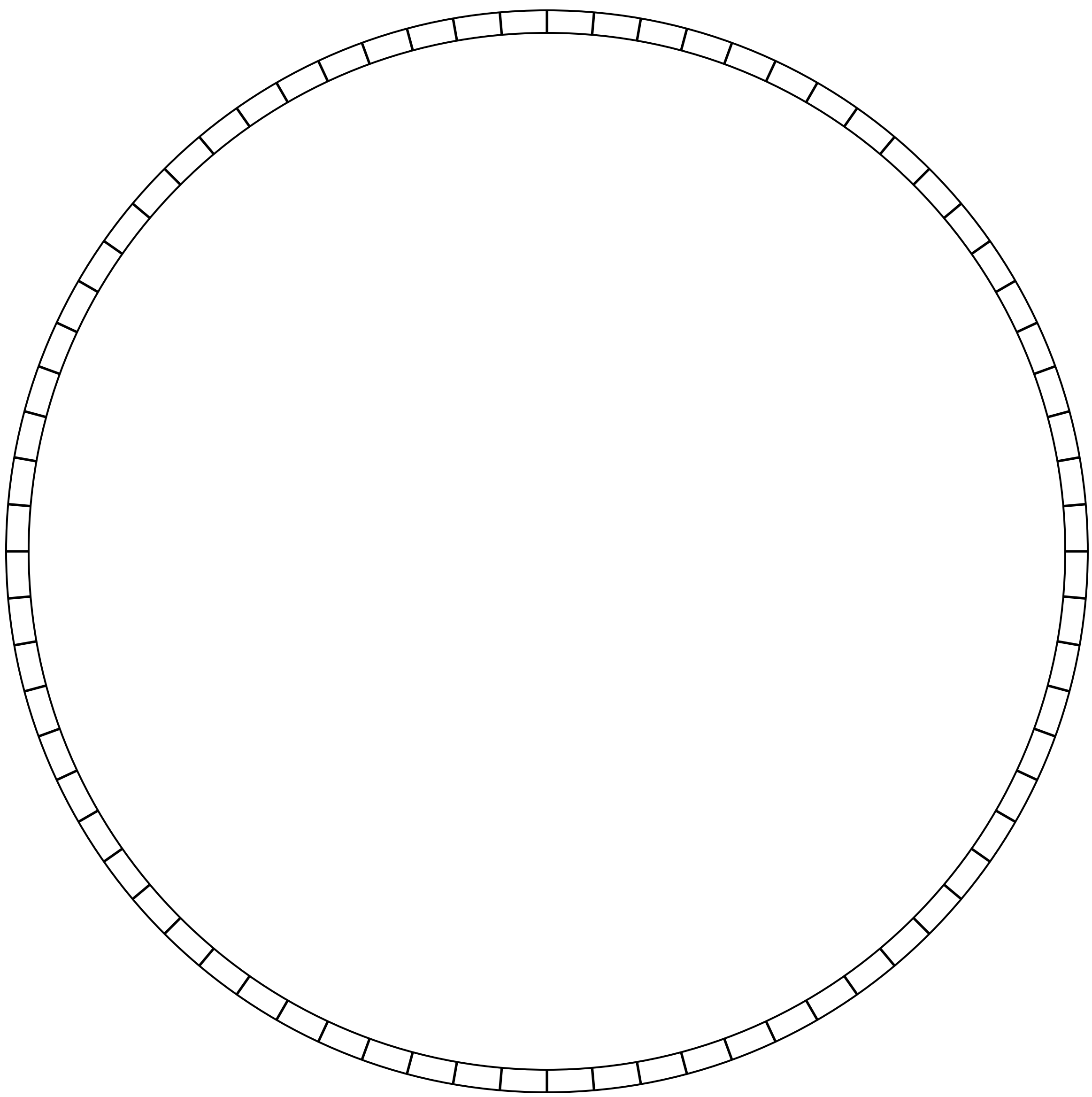












MATH .... ____/50
Proportions, calculations, angles, percents
MEASUREMENT......... ____/25
Parallel & perpendicular lines,
proportion boxes, straight lines
PRESENTATION......... ____/25
coloring, lettering, spelling, erasures

Other__________________________

TOTAL:...................... ____/100

MATH .... ____/50
Proportions, calculations, angles, percents
MEASUREMENT .... ____/25
Parallel & perpendicular lines,
proportion boxes, straight lines
PRESENTATION .... ____/25
coloring, lettering, spelling, erasures

Other__________________________

TOTAL:...................... ____/100

MATH .... ____/50
Proportions, calculations, angles, percents
MEASUREMENT......... ____/25
Parallel & perpendicular lines,
proportion boxes, straight lines
PRESENTATION......... ____/25
coloring, lettering, spelling, erasures

Other__________________________

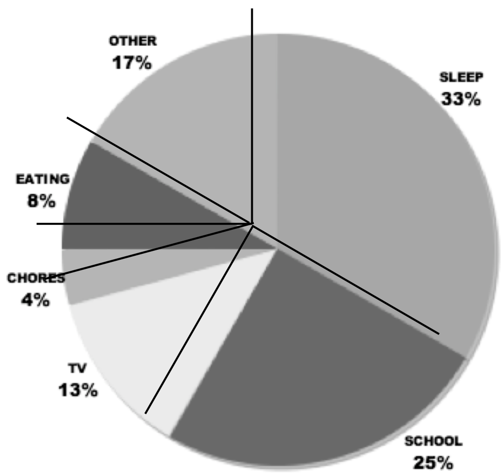
TOTAL:...................... ____/100

MATH .... ____/50
Proportions, calculations, angles, percents
MEASUREMENT .... ____/25
Parallel & perpendicular lines,
proportion boxes, straight lines
PRESENTATION .... ____/25
coloring, lettering, spelling, erasures

Other__________________________

TOTAL:...................... ____/100

A DAY IN AMY'S LIFE



SLEEP

8	x
24	13

x = 4.3 yrs.

SCHOOL

6	x
24	13

x = 3.2 yrs.

TV

3	x
24	13

x = 1.6 yrs.

CHORES

1	x
24	13

x = .5 yrs.

EATING

2	x
24	13

x = 1.1 yrs.

OTHER

4	x
24	13

x = 2.2 yrs.


THE LIFE OF ASHLEE
Sleeping 42%
Eating 4%
Music 8%
Video games 17%
Other 4%
School 25%
School
DAY LIFE
Part 6 X
whole 24 13.5
6·13.5÷24≈3.4
Eating
DAY LIFE
Part 1 X
whole 24 13.5
1·13.5÷24≈0.6
music
DAY LIFE
Part 2 X
whole 24 13.5
2·13.5÷24≈1.1
Sleeping
DAY LIFE
Part 10 X
whole 24 13.5
10·13.5÷24≈5.6
videogames
DAY LIFE
Part 4 X
whole 24 13.5
4·13.5÷24≈2.3
Other
DAY LIFE
Part 1 X
whole 24 13.5
1·13.5÷24≈0.6