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A Curriculum Project on Understanding Percent Aligned to Common Core State Standards

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Standards

By

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Chapter 1: Introduction

For the first time in the United States history there is one set of national standards in Mathematics called the Common Core State Standards for Mathematics (CCSSM). In 2010, the National Governors Association Center for Best Practices (NGA Center) and the Council of Chief State School Officers (CCSSMO) released the first set of nation standards. By March 2014, 44 states, Departments of Defense Education Activity, Washington D.C., Guam, the Northern Mariana Islands and the Virgin Islands have voluntarily adopted these standards.

Alberti (2012/2013) claimed that the widespread adoption of the CCSSM has done little to change education rather it is an opening of the door to better education. Yet, change is occurring at all levels with the need for schools to redesign their curriculum to align with the materials created from the Race to The Top funds for each state. Additionally there is no data available to show progress of student learning since the CCSSM have only been around for a few years. "The biggest risk we currently face is full-speed implementation without an understanding of the changes that the standards require" (Alberti, 2012/2013).

This thesis is designed as a resource for teachers, coaches, and curriculum coordinators from the U.S. states and territories that are in the process of developing materials and curriculum to support the implementation of the CCSSM and those who have already implemented the CCSSM. This thesis provides the history of standards, reasons for the development of the CCSSM, changes from the National Council of

Teachers of Mathematics (NCTM) Standards to the CCSSM, and a sixth grade unit

plan on understanding percent aligned to the CCSSM.

Chapter 2: Literature Review

History of State Standards

      The CCSSM came about due to discrepancies between student performances on state standards, national and international assessments. In 1989, the NCTM developed a general agreement of what students should know in the *Curriculum and Evaluation Standards for School Mathematics.* The NCTM wanted to address the lagging student performance on national and international assessments. Their ideas were influenced by the rise of constructivism and technological advances. Other national organizations began to develop their own standards as well. By late 1990s, states adopted their own standards for students' performance and assessment. "Educators and public officials grew concerned that national standards were politically toxic in a country that valued local control of education policy." (Rothman, 2013) Every state was required by the No Child Left Behind Act of 2002 (NCLB) to administer the National Assessment of Educational Progress (NAEP) twice a year. The data showed student performance on NAEP did not align with the performance on state standards.

      "For example, in Tennessee, 87 percent of fourth grades were proficient in mathematics in 2005 according to state standards, compared with 28 percent who were proficient on the NAEP. Meanwhile, In Massachusetts the proportion of students proficient on both tests were about the same." (Rothman, 2013)

The Trends in International Math and Science Study (TIMSS) is an international assessment. The assessment measures curriculum-based knowledge in mathematics and science for fourth and eighth grade students. This assessment was given to developing and developed countries. Of these developed countries, eight were recognized as the most industrialized countries in the world. These countries were the U.S., Canada, France, Germany, Italy, Japan, the Russian Federation, and the United Kingdom. These countries met regularly to discuss economic and other policies issues. (National Science Board, 2006)

Data from the 2003 TIMSS report showed that fourth graders in the U.S. had lower average scores than students in Japan, Russia, and England, but higher average scores than students in Italy. The U.S. eighth graders were outperformed by students in Japan and scored higher averages than students in Italy. They scored equivalently with students in Russia. The data from the 1995 to 2003 TIMSS shows the average scores of fourth graders did not change and the average scores for eighth graders scores slightly improved. Based on the goals of the U.S. Department of Education's National Commission on Excellence, the Education system in the United States is always striving to be the best. The data from TIMSS shows that the U.S. has not achieved this position as of yet. (National Science Board, 2006)

The Program for International Student Assessment measures a 15-year-old students' ability to apply scientific and mathematical concepts and skills. The Organization for Economic Co-operation and Development (OECD) nations participated in this assessment which include Australia, Austria, Belgium, Canada,

Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain Sweden Switzerland, Turkey, the United Kingdom, and the United States. In 2003, the U.S. was outperformed by students in Canada, France, Germany, the Netherlands, South Korea, Japan, and 14 other countries. The U.S. scored equivalently with Hungary, Poland, and Spain, and scored higher than Greece, Italy, Mexico, Portugal, and Turkey. The U.S. performed below the average for the OECD. The data from the 2000 to 2003 PISA showed no changes in the U.S. performance and the U.S. average fell below the average of the OECD. This data shows that students are lacking in skills of applying mathematical knowledge. (National Science Board, 2006)

The U.S. is spending more money on educational, but is underperforming many countries on math test scores. The U.S. education spending and performance is compared to the following eleven countries: Japan, Australia, Brazil, Canada, France, Germany, Russia, Finland, Mexico, United Kingdom, and South Korea. The U.S. total annual spending on education is $809.6 billion which is far above the second highest spending nation Japan at $160.5 billion. The third highest spending nation is Germany with $129.8 billion. The U.S. annually spends $7,743 per school-aged child which is defined as ages 6-23 year olds. (U.S. Education Spending, 2011)

By further examining the statistics of the U.S., Russia and Finland data showed large discrepancies. The U.S. spends $7,743, Finland $5,653, and Russia $1,850 annually per school-aged child. With a possible high score of 600, the U.S.

scored 474, Finland 548, and Russia 476 on the math test. The U.S. spends about three times as much as Russia per student, but has slightly lower math scores. Comparing the U.S. to Finland, the U.S. significantly underperforms while still out spending Finland. The data suggests that the U.S. is the most inefficient math educator based on the test performance vs. the amount of money spent. (U.S. Education Spending, 2011)

Common Core State Standards for Mathematics

Forty-four states, the District of Columbia, and four territories are currently switching from the NCTM Standards to the CCSSM. This is the first time the U.S. has ever had national standards. Prior to these national standards each state had their own standards to abide by. Of these states, some have adopted and fully implemented the standards while others are still in the process of full implementation. The CCSSM are coordinated by the NGA Center and the CCSSMO, and is led by the states. Teachers, school administrators, and experts collaborated to develop the CCSSM aiming to provide a clear and consistent framework to prepare students for a future in college and careers. Also, the best models from around the world contributed in developing standards. The goals of the CCSSM are to improve the curriculum, instruction, assessment, professional development, and student achievement in mathematics (CCSSM, 2010).

Data from the statistical analysis report *Remedial Education at Degree-Granting Postsecondary Institutions* published in the fall of 2000 showed about a third of students were required to take remedial courses at universities and colleges

(Parsad, Lewis, 2003). Even though a third of these students met state standards and graduated from high school, they were not sufficiently prepared for higher education. Their state standards did not provide the base knowledge needed to pursue higher level mathematics. The proponents of the CCSSM claim to prepare students for careers and colleges (CCSSM, 2010). The standards were developed and drafted by chief state school officers, governors, Achieve, College Board, ACT, Student Achievement Partners, content area experts, and math and English language arts people (Haycock, 2010). These standards provide a foundation for a "robust curricula, along with high quality lessons, units, and assignments from which they can draw" from and "high-quality examinations that probe student mastery" in order to prepare students for college (Haycock, 2010).

According to Coleman, one of the many authors to the Common Core, the three principles behind the CCSSM are for students to be career and college ready, that these standards are based on evidence, and that time is taken seriously (King Jr., Coleman, 2011).

The CCSSM stresses conceptual understanding of key ideas and continually returns to organized principals (CCSSM, 2010). The standards put an equal importance on mathematical understanding and procedural skills (CCSSM, 2010). Then students will understand why and how certain procedures are used rather than relying on memorization. This deviates students from relying only on procedures and creates an enriched understanding of mathematics. The CCSSM emphasize the importance of mathematical understanding along with procedural skills.

The CCSSM stress the importance of continuous learning of mathematical material. Teachers repeatedly review or recall previously learned material to re-introduce or elaborate more on the new material. Excellent teachers are continuously building off of prior knowledge and making connections to help students build their understanding of the material. This familiarizes students with the relationships amongst one topic to the next. If students are aware of how related mathematics materials are, then they will develop a better understanding of mathematics as a whole.

The CCSSM aims for all students to learn by holding everyone to the same expectations. The authors of the CCSSM claim these standards were developed for all types of learners including English language learners and students with disabilities. The CCSSM provides the minimum information that all students should know. (CCSSM, 2010)

The CCSSM has a unique structure compared to the NCTM Standards. From kindergarten to eighth grade each standard has several focus areas and critical areas of understanding. Each grade level states the related principals from prior grades. Topics that are going to be built on, from previous grades, are clearly pointed out. At the end of each grade level, the standard states how students are prepared for the following grade. The standards for high school are now listed by the following conceptual categories: number and quantity, algebra, functions, modeling, geometry, and statistics and probability (CCSSM, 2010). This new structure provides guidelines for teachers to determine how the new curriculum should look.

Therefore, CCSSM is a new unified system of standards to educate all students across the United States. For this reason, teachers are required to create new curriculums, units, lessons, and assignments. Teachers determine the order and methods to teaching the standards. Then eventually the progress of education will be analyzed to bring insight to how students learn best. Subsequently, adjustments will be made to increase learning for all students.

The CCSSM consists of standards, clusters, domains, and mathematical practices. The CCSSM states "standards define what students should understand and be able to do", "clusters summarize groups of related standards", and "domains are larger groups of related standards." (CCSSM, 2010) The mathematical practices consist of standards that "describe varieties of expertise that mathematics educators at all levels should seek to develop in their students." (CCSSM, 2010) These mathematical practices are used throughout all grade levels where applicable. The eight mathematical practices are the following:

1. Make sense of problems and preserve in solving them.

2. Reason abstractly and quantitatively.

3. Construct viable arguments and critique the reasoning of others.

4. Model with mathematics.

5. Use appropriate tools strategically.

6. Attend to precision.

7. Look for and make use of structure.

8. Look for and express regularity in repeated reasoning.

Shift 1: Focus

The first shift from the state standards to the CCSSM is the focus of standards (Shifts in Mathematics, 2011). Mastery of these core focuses leads to higher-level mathematical thinking and understanding in high school and beyond.

"Common Core "Shifts"" states the following:

Teachers use the power of the eraser and significantly narrow and deepen the scope of how time and energy is spent in the math classroom. They do so in order to focus deeply on only the concepts that are prioritized in the standards so that students reach strong foundational knowledge and deep conceptual understanding and are able to transfer mathematical skills and understanding across concepts and grades.

This enables a higher potential for students' mastery of the prioritized topics and the ability to reach higher level mathematics in students' secondary and postsecondary education.

Teachers are in the process of becoming familiar with the prioritized topics for the grade levels they are teaching as well as previous and post grade levels. The teachers' foundation of knowledge and the student's mastery of topics will allow more time to spend on learning new concepts and developing a deeper understanding. Focus is one of the main themes for the CCSSM because the time spent in developing a deeper understanding of mathematics will last longer from grade to grade as well as higher education.

The CCSSM aims to fix the state standards issue of being "a mile wide and an inch deep" by giving teachers the freedom to teach how they want and more in-depth (Schmidt, Houang, Cogan, 2002). Previously under the state standards, teachers either did not cover all the material or these were quickly brushed over. Concepts are not only related amongst other concepts in a particular grade level, but also previous and future grade levels. When students are continuously pushed onto the following topics they are losing valuable information that is key to becoming proficient in mathematics. Hence, the importance of time to deepen the student's understanding is evident and the CCSSM aim for improvement here. The objective for the CCSSM is to allow teachers enough time to teach, and students to learn and master mathematical skills that are useful for the future.

In the video *Common Core in Mathematics: Shift 1- Focus*, David Coleman, contributing author to the CCSSM, states that kindergarten to second grade is focused on "addition and subtraction, measuring using whole number quantities" (King Jr., Gerson, Coleman, 2011). He also says that grades three to five are now focused on "multiplication and division of whole numbers and fractions". Sixth grade now focuses on "ratios and proportional reasoning; early expressions and equations." Seventh grade focuses on "ratios and proportional reasoning; arithmetic of rational numbers," while eighth grade focuses on linear algebra (King Jr., Gerson, Coleman, 2011). Some of these changes were implemented based on Hong Kong, Korean, and Singapore standards because of their high performance on the TIMSS (Ginsburg, Leinwand, Decker, 2009).

Shift 2: Coherence

The second shift from state standards to the CCSSM is the coherence of mathematical knowledge (Shifts in Mathematics, 2011). The major topics are linked within and across grades. Teachers are making connections to students' background knowledge of content to create a foundation upon which they can build a deeper conceptual understanding of the core content. The learning process is viewed as an extension of previous learning instead of a new learning event. By incorporating students' background knowledge into the learning process, students are able to build their confidence in learning new materials and become more engaged in the learning process as well. "Principals and teachers carefully connect the learning within and across grades so…students can build new understanding onto foundations built in previous years" (Shifts in Mathematics, 2011). With the state standards, teachers found students coming into class lacking prior knowledge of important concepts that were necessary for learning the new concepts. The CCSSM hopes to change this by allowing greater mastery which would provide a smoother transition between grades. The CCSSM aims to prepare students through the standard's coherence of learning.

"The coherence and sequential nature of mathematics dictates the foundational skills that are necessary for the learning of algebra. The most important foundational skill not presently developed appears to be proficiency with fractions (including decimals, percentages, and negative fractions). The teaching of fractions must be acknowledged as critically important and

improved before an increase in student achievement in algebra can be

expected." (National Mathematics Advisory Panel, 2008)

Shift 3: Fluency

The third shift from state to the CCSSM is the fluency of performing simple

operations (Shifts in Mathematics, 2011). The standards require calculations to be

completed with speed and accuracy. Teachers structure class time and homework to

develop procedural skills. Students must have the basic operations down so they can

move onto higher thinking and more complex topics. For example, students need to

develop an understanding of fractions before being introduced to percentages. Hence,

students develop an understanding of fractions from third to fifth grade before they

can learn about percentages in sixth grade. Students will be able to utilize their

knowledge throughout their entire education from elementary school to high school to

college to career.

Shift 4: Deeper Understanding

The fourth shift is the ability to develop a deeper understanding of

mathematics (Shifts in Mathematics, 2011). The new standards allow teachers and

students to develop solid conceptual understanding with focused set of standards.

> "There is less pressure to quickly teach students how to get the answer, which
>
> often means relying on tricks or mnemonics instead of understanding the
>
> reason an answer is correct or why a particular trick works. For example, it is
>
> not sufficient for students to know they can find equivalent fractions by
>
> multiplying the numerator and denominator by the same number. Students

also need to know why this procedure works and what the different equivalent forms mean. Attention to conceptual understanding helps students build on prior knowledge and create new knowledge to carry into future grades. It is difficult to build further math proficiency on a set of mnemonics or meaningless procedures." (Alberti, 2012/2013)

Teachers instruct students to apply their conceptual understanding to new situations. Students develop a deep understanding of mathematics by speaking, listening, reading, and writing about it (Thompson, Chappell, 2007). Teachers need to demonstrate literacy and encourage students to use their speaking, listening, reading, and writing skills. Students will then be able to communicate their understanding of mathematic words, symbols, and concepts to teachers, peers, and others. Students need to be taught how to organize and consolidate mathematics to communicate coherently and clearly. Some exercises are journals, learning logs, daily diaries, explanations, personal dictionaries, and link sheets. These exercises deepen the student's understanding of mathematics. Since mathematics has such a unique language, it needs to be practiced extensively in the mathematics classroom.

Shift 5: Application

The fifth shift is application of mathematical learning (Shifts in Mathematics, 2011). Students need to know when and how to apply mathematics to solve problems. Especially, when they are not prompted to apply specific mathematical knowledge. A solid foundational understanding of concepts is essential for students before they are asked to solve real work problems. Without a solid foundation, students feel lost and

find these problems to be extremely hard and too difficult for them to solve. "Application can be motivational and interesting, and students at all levels need to connect the mathematics they are learning to the world around them." (Alberti, 2012/2013) Teachers will continue providing real life situations for students to apply appropriate math skills that are necessary for problem solving. Thus, students will be prepared to apply mathematical skills in their everyday lives.

Problem solving is valued highly in the mathematical curriculum and incorporated in the CCSSM for Mathematical Practices. "Problem solving is an excellent source and vehicle for enrichment in mathematics" (Posamentier, Smith, Stepelman, 2010). When students are solving a problem, they are required to think in-depth and beyond normal thinking. Problem solving goes further than memorization of formats and procedures. Students are given a chance to explore problems and come to their own conclusions making their learning more meaningful. The answer is not always the most important aspect of math, but the process one takes to derive the answer is the most important. This gives students a sense of accomplishment and achievement when solving problems. The skills needed for problem solving carry over into all areas of the mathematics curriculum as stated by the Mathematical Practices (CCSSM, 2010).

Shift 6: Duel Intensity

The sixth and final shift is the duel intensity of practicing and understanding mathematics (Shifts in Mathematics, 2011). Teachers provide students with many opportunities to practice mathematical skills to build understanding. This shift goes

hand in hand with the shifts in fluency and application. Through this duel intensity of practice and understanding, students will become fluent in processes that are applied to extended applications.

Mathematical Practices

The Mathematical Practices are the processes and proficiencies that all students of any grade level will develop and become proficient in over time. The following are the eight mathematical practices: make sense of problems and preserve in solving them, reason abstractly and quantitatively, construct viable arguments and critique the reasoning of others, model with mathematics, use appropriate tools strategically; attend to precision, look for and make use of structure, and look for and express regularity in repeated reasoning (CCSSM, 2010). Therefore, Teachers should incorporate these mathematical practices into everyday instruction to develop mathematically proficient students.

The CCSSM provides precise processes that are interconnected. These processes were developed from the NCTM process standards of problem solving, reasoning and proof, communication, representation, and connections (CCSSM, 2010). The process standards from the CCSSM are of the same nature of the five process strands from the NCTM Standards. The only difference is that the CCSSM breaks these five standards into eight processes. Since these five standards can be considered interconnected, the CCSSM breaks these down into specific and clear processes. Also, these provide descriptions of what proficiency means for each

process. Thus, teachers are provided with a well-defined understanding of the processes' proficiencies.

The CCSSM breaks the five process strands into eight practices with specific focuses. The first Mathematical Practice, making sense of problems and preserve in solving them, is certainly the problem solving strand. Problem solving is the process of understanding a given problem and devising a process to come to a solution.

The second practice, reasoning abstractly and quantitatively, is defined as the strand of reasoning. Reasoning is the process of looking at concepts abstractly which is the ability to think beyond the literal of that concept and explore to the less concrete concepts. Also, students can reason quantitatively by solving a problem and representing it and being particular about the units of the quantities, and other associated properties.

The third practice, constructing viable arguments and critiquing the reasoning of others, is a mixture of both the communication and proof strands. In order to communicate mathematically, students need to mathematically understand how they themselves or another student derived their solutions. Also, students need to derive valid arguments in order to create or use proofs.

The fourth practice, modeling with mathematics, is classified as the representation strand. Students represent mathematics using models by mathematical procedures, charts, or graphs. These models illustrate their understanding.

The fifth practice, the use of appropriate tools strategically, can be defined by the problem solving strand. Students solve problems by use tools such as given information, calculators, or prior knowledge of concepts.

The sixth practice, attending to precision, is a combination of the communication, problem solving, and reasoning strands. In order to be successful at communicating, problem solving, and reasoning, students require accuracy by paying close attention to given information about definitions, measures, labels, and so forth.

The seventh and eighth practices, looking for and making use of structure and expressing regularity in repeated reasoning, are identified as the connection strand. Throughout the mathematics curriculum students are constantly making connections by looking for similarities of concepts. Then come to an understanding of how the concepts are related or expanded from one another. Therefore, all five of the NCTM Strands are covered in the eight practices from the CCSSM.

The Mathematical Practice's strands of mathematical proficiency were developed from the "National Research Council's report *Adding It Up*: adaptive reasoning, strategic competence, conceptual understanding (comprehension of mathematical concepts, operations and relations), procedural fluency (skill in carrying out procedures flexibly, accurately, efficiently and appropriately), and productive disposition (habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy)" (CCSSM, 2010). The CCSSM and the NCTM Standards both have the proficiency strands of conceptual understanding and procedural fluency. The only difference is that the

CCSSM has three more proficiencies and the NCTM Standards have only one more. The three additional proficiencies for the CCSSM are adaptive reasoning, strategic competence, and productive disposition, which are all necessary attributes to becoming a proficient problem solver. The last proficiency for the NCTM Standard is indeed problem solving. Thus, the CCSSM and NCTM Standards have very similar mathematical proficiencies.

One of the three main focuses of the CCSSM and the NCTM Standards is conceptual understanding. Conceptual understanding involves knowledge of mathematical ideas and processes, and the ability to apply them. The application of conceptual understanding entails being able to compare and contrast, and solving new problems which provides a foundation for further math growth. All eight of the Mathematical Practices enable students to build and use their knowledge of concepts. Conceptual understanding is highlighted in the CCSSM as well because it is a key element in higher level mathematics.

Another main focus of the CCSSM and the NCTM Standards is procedural fluency. This occurs during the process of solve step-by-step equations while having the ability to apply math concepts accurately across multiple subject areas. Once again all eight Mathematical Practices led allow students to develop and practice procedural fluency. This concept is one of three main focuses, because it provides a foundational approach to mathematics and is necessary for a wide ranged mathematical education.

The final component of the CCSSM and the NCTM Standards is problem solving. Problem solving at its basic level is the ability to solve or formulate an answer. This also entails the ability to analyze a problem and choose the most efficient solution. Furthermore, the Mathematical Practices one through eight are all necessary parts for students to build their problem solving skills. This concept is one of the main focuses because students need a wide variety of strategies to overcome difficulties with in the classroom and in their everyday lives.

Chapter 3

  The sixth grade unit plan detailed below is on understanding percent. All of the lessons within the unit are aligned to the CCSSM. The lessons fall under the Ratios and Proportional Relationship Domain and within the Cluster in which students understand ratio concepts and use ratio reasoning to solve problems. The unit addresses Standard 6.RP.3.c Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent. This unit was intended as a resource for teachers in any state that has and will adopt the CCSSM. The key to the entire unit plan is placed in the appendix.

  As shown in Table 1, the unit plan is displayed in a unit calendar covering six days. These lesson plans are meant for eighty minute blocks that meet every other day. Over four days, students develop an understanding of percent. The fifth day is dedicated to review. The unit test is on the sixth day. All student materials and the teacher's answer keys are below. All the materials needed are provided within the unit plan in the proper order. Starting with lesson one "understanding percent and all of the components" (warm up, examples, exercise, ticket out the door, homework etc.). The examples, exercises, and questions were strategically chosen to optimize students understand of each lesson. Students now have a few problems with similar formats instead of the typical twenty problems with similar formats found in textbooks. The unit plan was created from the following resources, New York State Grade 6 Mathematics Module 1 (2013), Common Core Edition CCSS Course 1

Volume 1 Teacher Walkaround Edition (Carter, Cuevas, Day, Malloy, 2013), and

Topic 14 Understanding Percent (Charles, Caldwell, Cavanagh, Copley, Crown,

Fennell,…,William, 2012).

Table 1

Unit Calendar

Monday	Tuesday	Wednesday	Thursday	Friday
Understanding Percent		Fractions, Decimals, and Percents		Percent of a Quantity
	Solving Percent Problems		Unit Test Review	
Unit Test				

Understanding Percent <u>Lesson 1: Understanding Percent</u>   **Name:**
                                                                     Date:
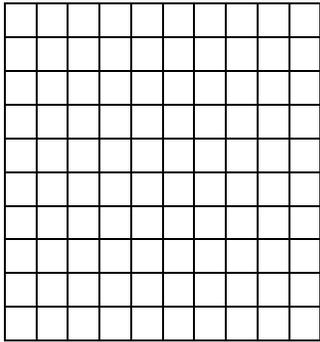
Essential Question: What is a percent?

Warm-up:
What are some different ways to show $\frac{1}{4}$ (one-fourth)?

A percent is _____
_____
_____

Real-World Connections:

Example:

Cent is the Latin word for hundred.

Percentage	Decimal	Fraction	Ratio	Model

Model: Use a different grid or drawing to show 20%

Understanding Percent <u>Lesson 1: Understanding Percent</u>

Exercise 1: Complete the table.

Percentage	Decimal	Fraction	Ratio	Model
6%			6 : 100	
60%				
600%				
32%				

Understanding Percent <u>Lesson 1: Understanding Percent</u>

	0.55			
0.5%		$\dfrac{5}{1000}$		

Be Precise What is the whole to which a percent is compared?

Generalize Why are tenths, fifths, and fourths easy to convert to percents?

Writing to Explain You are hungry so a friend has offered to give you 50% of his granola bar. What information must you have in order to find out how much of the granola bar your friend will give you?

Understanding Percent <u>Lesson 1: Understanding Percent</u>

Exercise 2
Robb's Fruit Farm consists of 100 acres, on which three different types of apples grow. On 25 acres, the farm grows Empire apples. McIntosh apples grow on 30% of the farm. The remainder of the farm grows Fuji apples. Shade in the grid below to represent the portion of the farm each apple type occupies. Use a different color for each type of apple. Create a key to identify which color represents each type of apple.
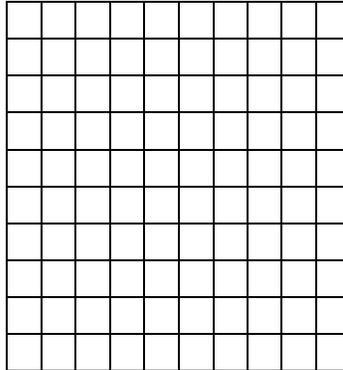
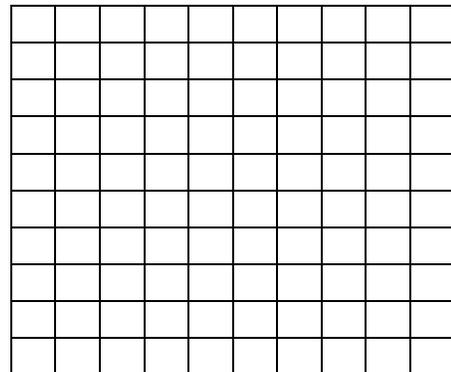| **Color Key**	**Part-to-Whole Ratio**	**Percent**
Empire_____	_____	_____
McIntosh _____	_____	_____
Fuji _____	_____	_____

Exercise 3
Jen is on a high school's basketball team. She can make 7 out of 10 foul shots. What percent of foul shots can Jen make?

What percent of foul shots does Jen miss?

How else can this percent be represented?

Understanding Percent Lesson 1: Understanding Percent

Exercise 4

Mr. Brown shares with the class that 70% of the students got an A on the English vocabulary quiz. If Mr. Brown has 100 students, create a model to show how many of the students passed.

What fraction of the students passed the class?

How could we represent this amount using a decimal?

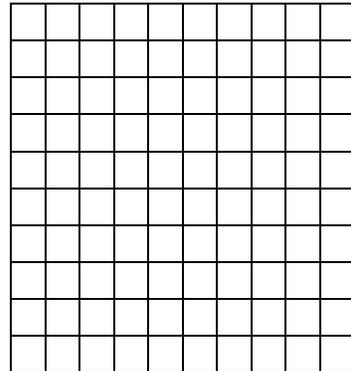How are the decimal, fraction, and percent all related?

Problem 1:
After renovations on Sarah's bedroom, only 30 percent of one wall is left without any décor. Shade the wall to represent the space that is left to decorate.

a. What does each square represent?

b. What percent has been decorated?

1. Complete the table.

Percentage	Decimal	Fraction	Ratio	Model
		$\dfrac{75}{100}$		
100%				
	0.35			

2. **Number Sense** Jane divided a sheet of paper into 5 equal sections and colored 2 of the sections red. What percent of the paper did she color?

3. **Writing to Explain** Shade each model to show 100%. Explain how you know how many parts to shade.
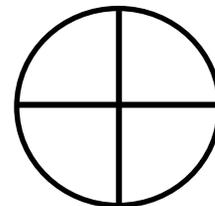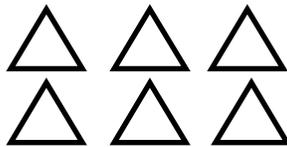
Understanding Percent <u>**Lesson 2: Fractions, Decimals, and Percents**</u>
Name: **Date:**
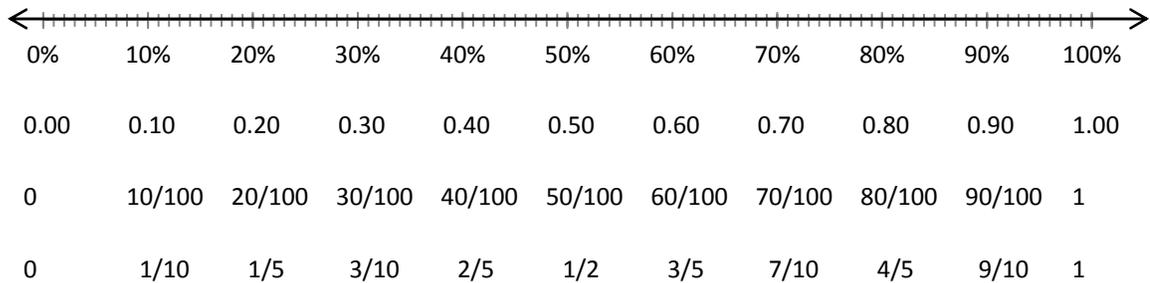
Essential Question: How can a percent be modeled?

Warm-up:
Marcus saves 80% of what he earns. How can you show this percent as a fraction in simplest form and as a decimal?

**Exercise 1** (Work in small groups and then come together for large group discussion)
Label the number line with percents, decimals, and fractions in simplest form.

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00
0	10/100	20/100	30/100	40/100	50/100	60/100	70/100	80/100	90/100	1
0	1/10	1/5	3/10	2/5	1/2	3/5	7/10	4/5	9/10	1

Understanding Percent Lesson 2: Fractions, Decimals, and Percents

Exercise 2
Use the given models to complete the tables.
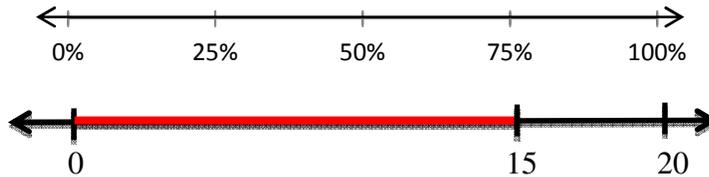
Ratio (Part: Whole)	Estimated Percent	Percent

Explain how you estimated the percent.

Ratio (Part: Whole)	Estimated Percent	Percent

Explain how you estimated the percent.

Understanding Percent Lesson 2: Fractions, Decimals, and Percents

Exercise 3
Each line segment below represents 100%, but the line segments are different lengths as shown on the double number line. Point *A*, *B*, and *E* are the same distance from zero on each line segment. Complete the table below by finding the fraction, decimal, and percent of point *A*, *B*, and *E*.

0%   *A*   100%

0   1   2

0%   *B*   *C*   *D*   100%

0   1   2   3   4

0%   *E*   *F*   *G*   *H*   100%

0   1   2   3   4   5
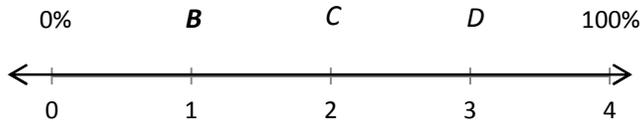
Point	Fraction	Decimal	Percent
A			
B			
E			

Are points A, B, and E the same distance from zero on the number line?

Does each segment represent the same part of the total length of the number line? Explain.

Use mental math to find the percents associated with the points *C, D, F, G* and *H*. Compare these points to either points B or E. Explain

How does a percent relate to the whole?

Understanding Percent Lesson 2: Fractions, Decimals, and Percents

Exercise 4
Use the tape diagram to answer the following questions.

0	1	2	3	4	5
0%	20%	40%	60%	80%	100%
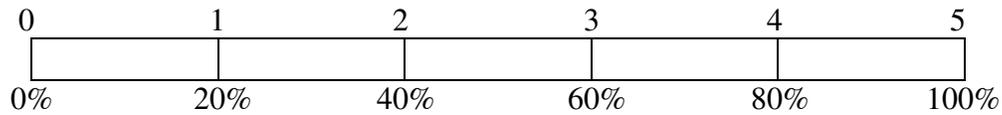
80% is what fraction of the whole quantity?

$\frac{1}{5}$ is what percent of the whole quantity?

50% is what fraction of the whole quantity?

1 is what percent of the whole quantity?

Exercise 5
Maria completed $\frac{3}{4}$ of her workday. Create a model that represents what percent of the workday Maria has worked.

What percent of her work day does she have left?

How does your model prove that your answer is correct?

Understanding Percent <u>Lesson 2: Fractions, Decimals, and Percents</u>
Name: **Date:**

Ticket Out the Door

Show all the necessary work to support your answer.

1. Convert 0.3 to a fraction and a percent.

2. Convert 9% to a fraction and a decimal.

3. Convert $\frac{3}{8}$ to a decimal and percent.

Understanding Percent <u>Lesson 2: Fractions, Decimals, and Percents</u>
Name: **Date:**

Homework

Use line segment $\overline{AB}$ to find the answers to **1** and **2**.

├─────────────────────────────────┤
   A   *B*

1. If line segment $\overline{AB}$ represents 50%, what is the length of a line segment that is 100%?

2. If line segment $\overline{AB}$ is 300%, what is the length of a line segment that is 100%?

3. Draw a picture to fine each percent.

     a. $\frac{3}{4}$

     b. $\frac{4}{5}$

     c. $\frac{13}{20}$

4. Each line segment below represents 100%. Estimate the percent that each point *A*, *B*, and *C* represent.
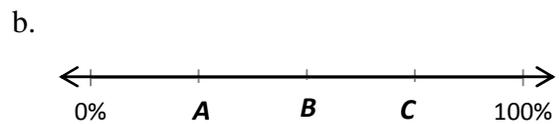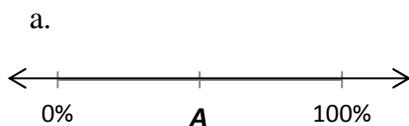
  a.

       0%   *A*   100%

  b.

   0%   *A*   *B*   *C*   100%

Understanding Percent <u>Lesson 2: Fractions, Decimals, and Percents</u>

Homework

5. **Writing to Explain** Jamal said that he could write a percent as a decimal by moving the decimal point two places to the left and deleting the percent sign, is he correct? How do you know? Give an example.

6. **Number Sense** Two stores sell their goods at the manufacturers' suggested retail prices, so their prices are the same. Which store has the greatest markdown from their original prices?

30% off
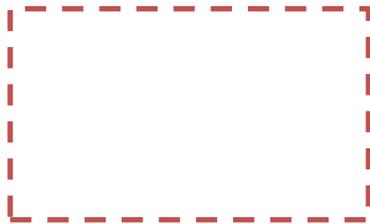
7. Make flash cards with one side the percent and the other side a fraction. Choose either the percent or fraction side and include a diagram or picture model. Use the following benchmark percents: 25%, 75%, 20%, 60%, 50%, 40%, 80%, and 100%.

Understanding Percent <u>Lesson 3: Percent of a Quantity</u>   Name:
                                                                          Date:

Essential Question: How are the part, whole, and percent found?

Warm up: (Example 1-3)
Example 1 Examples 1-3 partner work
Five of the 25 girls on Alden Middle School's soccer team are 7th-grade students. Find the percentage of 7th graders on the team. Show two different ways of solving for the answer. One of the methods must include a diagram or picture model.

Example 2
Of the 25 girls on the Alden Middle School soccer team, 40% also play on a travel team. How many of the girls on the middle school team also play on a travel team?

Understanding Percent <u>Lesson 3: Percent of a Quantity</u>

Example 3
The Alden Middle School girls' soccer team won 80% of their games this season. If the team won 12 games, how many games did they play? Solve the question using at least two different methods.

Exercise 1
There are 60 animal exhibits at the local zoo. What percent of the zoo's exhibits does each animal class represent?

Exhibits by Animal Class	Number of Exhibits	Percent of the Total Number of Exhibits
Mammals	30	
Reptiles & Amphibians	15	
Fish & Insects	12	
Birds	3	

Understanding Percent Lesson 3: Percent of a Quantity

Exercise 2
A sweater is regularly$32. It is 25% off the original price this week.
a. Would the amount the shopper saved be considered the part, whole or percent?

b. How much would a shopper save by buying the sweater this week? Show two methods for finding your answer.

Exercise 3
A pair of jeans was 30% off the original price. The sale resulted in a $24 discount.
a. Is the original price of the jeans considered the whole, part or percent?

b. What was the original cost of the jeans before the sale? Show two methods for finding your answer.

Understanding Percent Lesson 3: Percent of a Quantity

Exercise 4
Purchasing a TV that is 20% off will save $180.

a. Name the different parts with the words: PART, WHOLE, PERCENT.

_____   _____   _____
        20% off $180   Original Price

b. What was the original price of the TV? Show two methods for finding your answer.

Understanding Percent Lesson 3: Percent of a Quantity   **Name:**
Ticket Out the Door   **Date:**

1.) Find 40% of 60 using two different strategies, one of which must include a pictorial model or diagram.

2.) 15% of an amount is 30. Calculate the whole amount using two different strategies, one of which must include a pictorial model.

Understanding Percent Lesson 4: Solving Percent Problems   Name:
                                                                 Date:

Essential Question: How are multistep percent problems solved?

Warm Up:
Exercise 1
Solve the following three problems.

Write the words PERCENT, WHOLE, PART under each problem to show which
piece you were solving for.

60% of 300 = _____   60% of _____ = 300   60 out of 300 = _____%

How did your solving method differ with each problem?

Understanding Percent Lesson 4: Solving Percent Problems

Exercise 2
Use models, such as 10 x 10 grids, ratio tables, tape diagrams or double number line diagrams, to solve the following situation.

Priya is doing her back to school shopping. Calculate all of the missing values in the table below, rounding to the nearest penny, and calculate the total amount Priya will spend on her outfit after she received the indicated discounts.

	Shirt (25% discount)	Pants (30% discount)	Shoes (15% discount)
Original Price	$44		
Amount of Discount		$15	$9

What is the total cost of Priya's outfit?

Understanding Percent <u>Lesson 4: Solving Percent Problems</u>

Exercise 3
The following items were bought on sale. Complete the missing information in the table. Show your work below.

Item	Original Price	Sale Price	Amount of Discount	Percent Saved	Percent Paid
Television		$800		20%	
Sneakers	$80			25%	
Video Games		$54			90%
MP3 player		$51.60		40%	
Book			$2.80		80%
Snack Bar		$1.70	$0.30		

Understanding Percent <u>Lesson 4: Solving Percent Problems</u>   **Name:**
Ticket Out the Door   **Date:**

1.) Jane paid $40 for an item after she received a 20% discount. Jane's friend says this means that the original price of the item was $48.

        a.) How do you think Jane's friend arrived at this amount?

        b.) Is her friend correct? Why or why not?

2.) The sale price of an item is $160 after a 20% discount. What was the original price of the item?

Understanding Percent <u>Lessons 1-4</u>   Name:
Unit Test Review   Date:

Directions: Answer all the questions and show your work. Write answers in complete sentences.

1. What percent of the line segment is shaded?

2. What is 0.4% written as a decimal?

3. Most of the U.S. households spend about 5% of their income on entertainment. What fraction of a household's income is spent on entertainment? Write the fraction in simplest form.

4. The world population of cattle, pigs, sheep, and goats increased about 195% from 1961 to 2004. What fraction represents the population increase? Write the fraction in simplest form.

5. A study found that 9% of dog owners brush their dog's teeth. Of 578 dog owners, about how many would be expected to brush their dog's teeth?

6. Paula weeded 40% of her garden in 8 minutes. How many minutes will it take her to weed all of her garden?

0%   100%

0
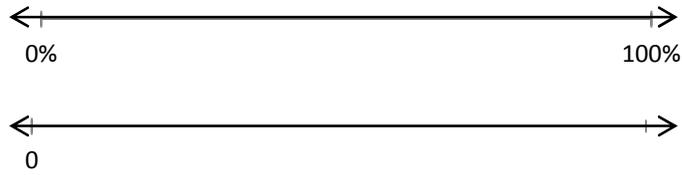
7. The table below shows the distribution of children at an elementary school. If there are 205 children in the school, about how many are in the 5th grade?

Enrollment by Grade	Percent
1st Grade	19%
2nd Grade	14%
3rd Grade	22%
4th Grade	26%
5th Grade	19%

.

8. All but 5 state capitals have an interstate highway serving them. What percent of 50 is 5?

9. What percent of the grid is shaded?
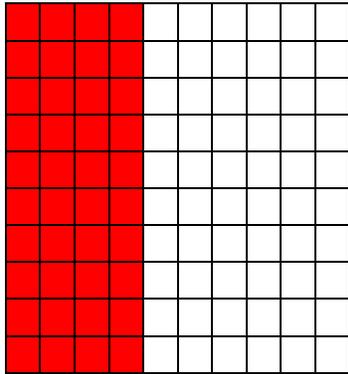
10. What proportion would you use to find 65% of 28?

11. If 20% of a number is 30, what is 50% of the number?

12. What is $\frac{7}{25}$ written as a percent?

13. What is the total amount if the percent is 16% and the part is 48?

14. About 25% of the students at a college are freshmen. Of those, about 50% are women. Does that mean that 75% of the students at the college are freshman women? Explain

15. Jill walked 6 blocks. This was 25% of her walk. How fare was Jill's walk?

16. Evan wants to buy a digital camera that sells for about $200. If he uses his discount car, he will save 18%. He only has $180 to spend.

a.) How much will he save using the discount card?

b.) How much will the scarf cost Sam?

c.) Can Sam afford the belt? Explain

Understanding Percent Lessons 1-4   Name:
Unit Test   Date:

Directions: Answer all the questions and show your work. Write answers in
complete sentences.

1. What percent of the line segment is shaded?
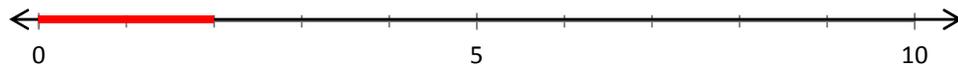
2. What is 68% written as a decimal?

3. The muscles in a human body normally account for about 40% of the total body
weight. What fraction of the human body is made up of muscles? Write the fraction in
simplest form.

4. The Earth's crust is about 2% titanium. What fraction of the Earth's crust is
titanium? Write the fraction in simplest form.

5. Scientists estimate that about 14 million species exist, and only about 15% of them
have been studied and named. About how many species have been studied and
named?

6. Jan knit 20% of a sweater in 5 days. How many days in all will it take Jan to finish the sweater?
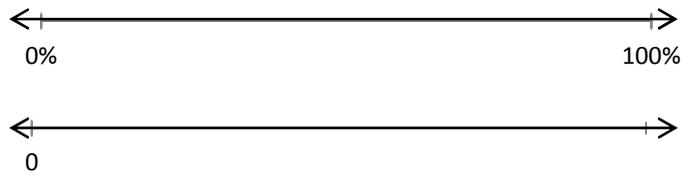
7. The table below shows the slope rating of runs at a ski resort. If there are 75 runs total, about how many are most difficult?

Sun Valley Resort Slope Rating	Percent
Easiest	36%
More difficult	42%
Most difficult	22%

8. Trevor got 18 out of 25 problems correct on a math test. What percent were correct answers?

9. What percent of the grid is shaded?
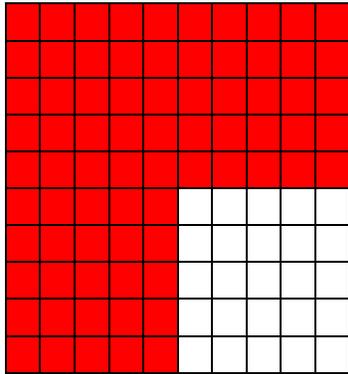
10. What proportion would you use to find 95% of 60?

11. If 10% of a number is 8, what is 80% of the number?

12. What is $\frac{9}{30}$ written as a percent?

13. What is the total amount if the percent is 32% and the part is 16?

14. About 30% of U.S. households own at least one cat. About 49% of cat owners own exactly one cat and the rest own more than one cat. Does that mean that 81% of U.S. households own more than one cat? Explain

15. Danny has 6 orange-colored shirts. This is 40% of the shirts he owns. How many shirts does Danny own?

16. Sam is shopping at Calvin Klein where there is a storewide sale of 25% off. She only has $25 of her allowance money to spend and Sam wants to buy a belt that originally costs about $40.

a.) How much money will Sam save with the sale?

b.) How much will the scarf cost Sam with the sale?

c.) Can Sam afford the belt? Explain

Chapter 4

The unit plan is designed to reflect the shifts from the NCTM Standards to the CCSSM, including the Standards for the Mathematical Practices, real life applications, extensions of learning, and deepening students' knowledge of percent.

The unit plan focuses on one standard from the CCSSM enabling students to develop a deep understanding of percent. Specifically Standard 6.RP.3.c Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent. Every lesson has warm-up questions, exercise, examples, and questions at the end of each lesson (tickets out the door) about percent.

The mathematical knowledge of percent is coherently addressed throughout each lesson. The lessons recall knowledge of sixth grade concepts of ratio and proportion. For example, Lesson 1: Understanding Percent, requires students' prior knowledge of fractions from their third grade, fourth grade, and fifth grade mathematics classes. Also students' are required to use their prior knowledge of decimals from fourth grade and fifth grade mathematics classes.

The fluency of performing simple operations is shown in the unit through the similar structure of exercises which allows students to practice mathematical operations that are focused on one concept. For example, Lesson 2: Fractions, Decimals, and Percents, Exercise 3, students fill out a chart with a fraction, decimal, and percent of points given on double number lines. Students are learning how a

percent is related to the whole while continuing to practice writing decimal, fraction, and percent.

The unit has various application problems within each lesson. For example in Lesson 1: Understanding Percent, Exercise 3, the ratio of foul shots Jen makes is given while the question asks for the percent of foul shots Jen missed. The question requires students to take the total number of foul shots and subtract that from the number of shots Jen did make. Then find the percent of foul shots Jen missed.

The unit is designed for duel intensity of practicing and understanding mathematics. The exercises within each lesson allow students to practice mathematical operations and develop their understanding of percent. Students learn how to write decimals, fractions, and percent while finding the part, whole, or percent throughout the entire unit. For example in Lesson 1: Understanding Percent, Exercise 1, students practice writing a percent as a decimal, fraction, ratio, and create a model with seven different percentages.

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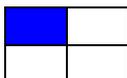**Understanding Percent Lesson 1: Understanding Percent**   **Name: Key**
   Date:

Essential Question: What is a percent?

Warm-up: Work with a partner
What are some different ways to show $\frac{1}{4}$ (one-fourth)?
Equivalent Fractions: multiply numerator and denominator by a constant number

$\frac{2}{8}, \frac{3}{12}, \frac{4}{16}, \frac{5}{20}, \frac{100}{400}$, **0.25, 1:4 or**

A percent is a special kind of ratio in which the first term is compared to 100. The percent is the number of hundredths that represents the part of the whole.

Real-World Connections:
Tipping a server at a restaurant, sales at stores, survey results, etc.

Example:

Cent is the Latin word for hundred

Percentage	Decimal	Fraction	Ratio	Model
20% **20 per<u>cent</u>** **20 per hundred**	**0.20** **Twenty hundredths**	**$\frac{20}{100}$** **Twenty hundredths**	**20:100**	

Model: Use a different grid or drawing to show 20%

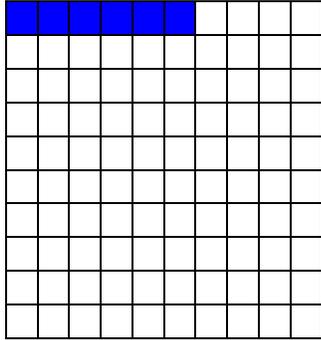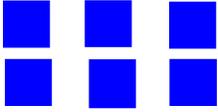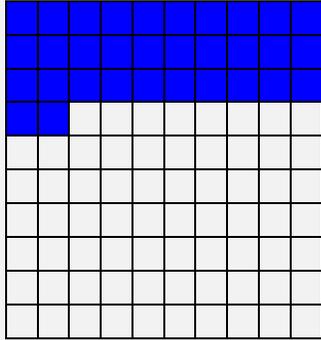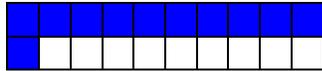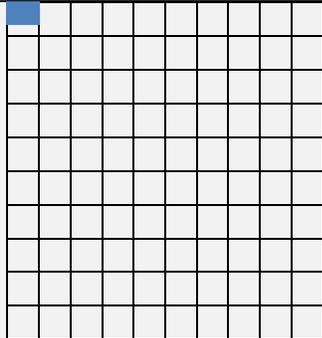$\frac{20}{100} = \frac{2}{10}$

Other possible answers

Understanding Percent Lesson 1: Understanding Percent

Exercise 1: Complete the table.

Percentage	Decimal	Fraction	Ratio	Model
6%	0.06	$\dfrac{6}{100}$	6:100	
60%	0.6	$\dfrac{60}{100}, \dfrac{6}{10}$	60:100	
600%	6	$\dfrac{600}{100} = \dfrac{6}{1}$	6:1	 *6 wholes*
32%	0.32	$\dfrac{32}{100}$	32:100	

Understanding Percent Lesson 1: Understanding Percent

55%	0.55	$\frac{55}{100}, \frac{11}{20}$	11 : 20	
0.5%	0.005	$\frac{5}{1000}$	5 : 1000	
70%	0.7	$\frac{7}{10}, \frac{70}{100}$	7 : 10	

Be Precise What is the whole to which a percent is compared?

100

Generalize Why are tenths, fifths, and fourths easy to convert to percents?
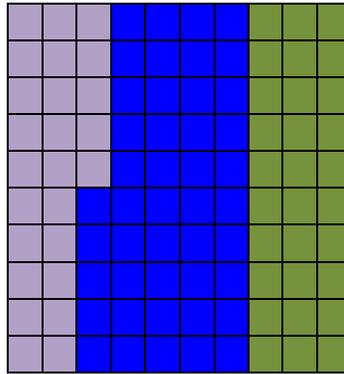
10, 5, and 4 are all factors of 100.

Writing to Explain You are hungry so a friends has offered to give you 50% of his granola bar. What information must you have in order to find out how much of the granola bar your friend will give you?

The total amount of water your friend has.

Understanding Percent Lesson 1: Understanding Percent

Exercise 2
Robb's Fruit Farm consists of 100 acres, on which three different types of apples grow. On 25 acres, the farm grows Empire apples. McIntosh apples grow on 30% of the farm. The remainder of the farm grows Fuji apples. Shade in the grid below to represent the portion of the farm each apple type occupies. Use a different color for each type of apple. Create a key to identify which color represents each type of apple.

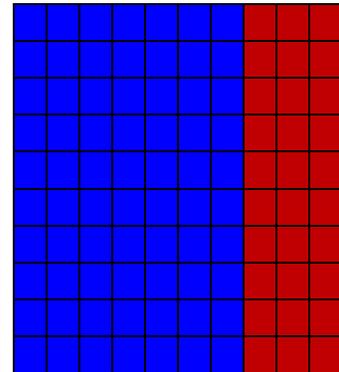| **Color Key**		**Part-to-Whole Ratio**	**Percent**
Empire	*purple*	25:100	25%
McIntosh	*green*	30:100	30%
Fuji	*blue*	45:100	45%

Exercise 3
Jen is on a high school's basketball team. She can make 7 out of 10 foul shots. What percent of foul shots can Jen make?

$$\frac{7}{10} = \frac{70}{100} \qquad 70\%$$

What percent of foul shots does Jen miss?
100%-70%=30%

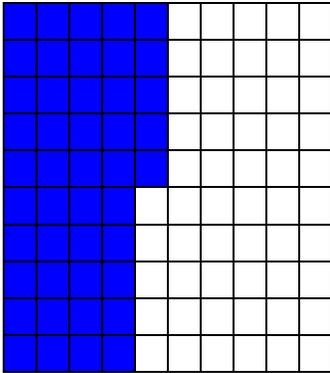How else can Jen's percentage of missed foul shots be represented? **0.30, 0.3,**
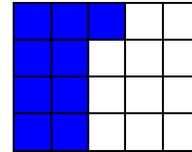$\frac{30}{100}, \frac{3}{10},$

Understanding Percent Lesson 1: Understanding Percent

Exercise 4

Mr. Brown shares with the class that 45% of the students got an A on the English vocabulary quiz. If Mr. Brown has 100 students, create a model to show how many of the students passed.

$$\frac{45}{100} = \frac{9}{20}$$

What fraction of the students passed the class?

$$\frac{45}{100} \text{ } or \text{ } \frac{9}{20}$$

How could we represent this amount using a decimal?

$$45 \div 100 = 0.45 \text{ } or \text{ } 9 \div 20 = 0.45$$

How are the decimal, fraction, and percent all related?
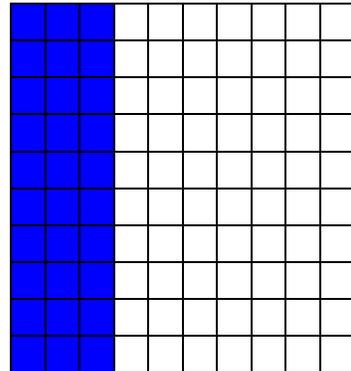
The decimal, fraction, and percent all show 45 out of 100.

Problem 1:
After renovations on Kim's bedroom, only 30 percent of one wall is left without any décor. Shade the wall to represent the space that is left to decorate.

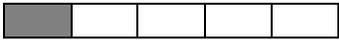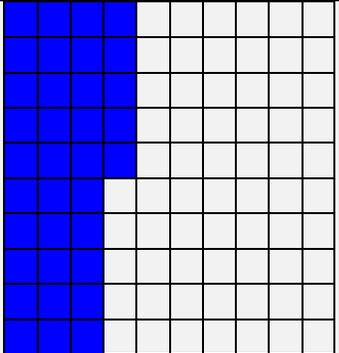a. What does each square represent?

$$\frac{1}{100} \ or \ 0.01$$

b. What percent has been decorated?

$$100\% - 30\% = 70\%$$

Understanding Percent Lesson 1: Understanding Percent Homework

Name: Key
Date:

1. Complete the table.

Percentage	Decimal	Fraction	Ratio	Model
75%	**0.75**	$\dfrac{75}{100}$	**3:4**	
100%	**1.00**	$\dfrac{100}{100}$	**1:1**	
20%	**0.20**	$\dfrac{1}{5}, \dfrac{20}{100}$	**1:5**	
35%	**0.35**	$\dfrac{7}{25}, \dfrac{35}{100}$	**35:100**	

2. **Number Sense** Jane divided a sheet of paper into 5 equal sections and colored 2 of the sections red. What percent of the paper did she color?

$$\frac{2}{5} = \frac{40}{100}$$
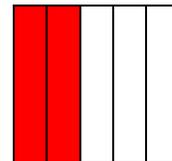
Jane colored 40% of the paper.

3. **Writing to Explain** Shade each model to show 100%. Explain how you know how many parts to shade.

100% means 100 parts per 100 so all models will be filled in.

Understanding Percent Lesson 2: Fractions, Decimals, and Percents
Name: Key   **Date:**

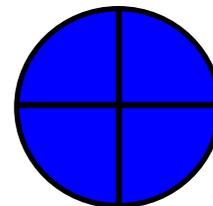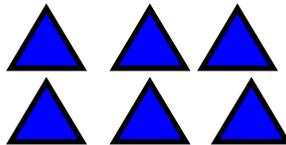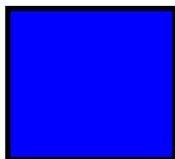**Essential Question:** How can a percent be modeled?

Warm-up:
Marcus saves 80% of what he earns. How can you show this percent as a fraction in simplest form and as a decimal? **Have students discuss with a partner then pass out a number line with 100 parts.**

$$80\% \quad \frac{80}{100} = \frac{4}{5} = 0.80 \; or \; 0.8$$

Exercise 1 (Work in small groups and then come together for large group discussion)
Label the number line with percents, decimals, and fractions in simplest form.

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00
0	10/100	20/100	30/100	40/100	50/100	60/100	70/100	80/100	90/100	1
0	1/10	1/5	3/10	2/5	1/2	3/5	7/10	4/5	9/10	1

Understanding Percent Lesson 2: Fractions, Decimals, and Percents

Exercise 2
Use the given models to complete the tables.

| 0% | 25% | 50% | 75% | 100% |

0   15   20
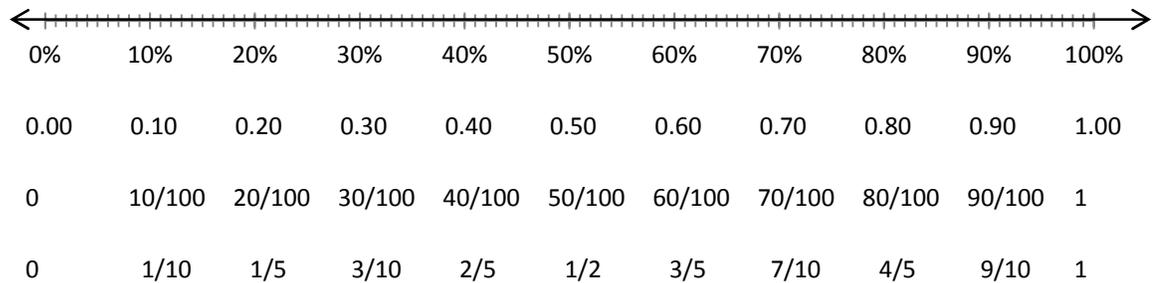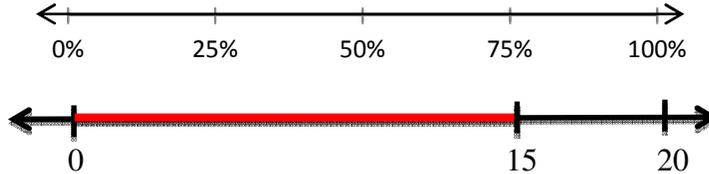
Ratio (Part: Whole)	Estimated Percent	Percent
$15:20$	75%	$\dfrac{15}{20} = \dfrac{75}{100}\ 75\%$

Explain how you estimated the percent. Half of the whole is 10 so that is 50%. Half way between 10 and 20 is 15 which is 25%. So altogether the model represents 75%.

0   20   82

Ratio (Part: Whole)	Estimated Percent	Percent
$20:82$	25%	$\dfrac{20}{82} = 0.2439024$ 24.39%

Explain how you estimated the percent. **Half of the whole is 41 which is at 50%. Half of a half is 20.5, which is 25% of the whole.**

Understanding Percent Lesson 2: Fractions, Decimals, and Percents

Exercise 3
Each line segment below represents 100%, but the line segments are different lengths as shown on the double number line. Point *A*, *B*, and *E* are the same distance from zero on each line segment. Complete the table below by finding the fraction, decimal, and percent of point *A*, *B*, and *E*.

0%	*A*	100%

0   1   2

| 0% | *B* | *C* | *D* | 100% |

0   1   2   3   4

| 0% | *E* | *F* | *G* | *H* | 100% |

0   1   2   3   4   5
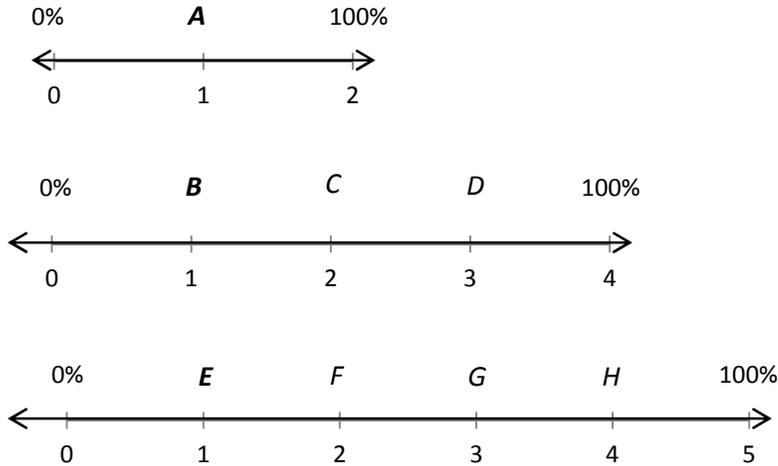
Point	Fraction	Decimal	Percent
A	$\frac{1}{2}$	0.5	50%
B	$\frac{1}{4}$	0.25	25%
E	$\frac{1}{5}$	0.20	20%

Are points A, B, and E the same distance from zero on the number line? **Yes**

Does each segment represent the same part of the total length of the number line? Explain. **No, because each line is a different length.**

Use mental math to find the percents associated with the points *C,D, F, G* and *H*. Compare these points to either points B or E. Explain. **Point C is 50%, point D is 75%, point F is 40%, point G is 60%, and point H is 80%**

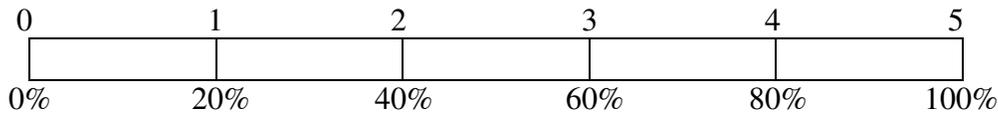How do percents relate to the whole? **Percent is relative to the size of the whole.**

Understanding Percent Lesson 2: Fractions, Decimals, and Percents

Exercise 4

Use the tape diagram to answer the following questions.

0	1	2	3	4	5
0%	20%	40%	60%	80%	100%

80% is what fraction of the whole quantity?

$$\frac{1}{4}$$

$\frac{1}{5}$ is what percent of the whole quantity?

20%

50% is what fraction of the whole quantity?

$$\frac{2\frac{1}{2}}{5} \ or \ \frac{2.5}{5} = \frac{25}{50} = \frac{5}{10}$$

1 is what percent of the whole quantity?

$$1 = \frac{5}{5} \quad \textbf{This would be 100\%}$$

Exercise 5

Maria completed $\frac{3}{4}$ of her workday. Create a model that represents what percent of the workday Maria has worked.

0%	25%	50%	75%	100%
0	¼	½	¾	1
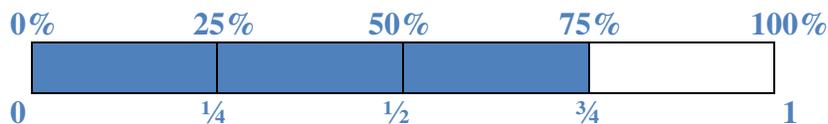
She has completed 75% of her workday.

What percent of her work day does she have left?
25%

How does your model prove that your answer is correct?
My model shows that $\frac{3}{4} = 75\%$, and that the $\frac{1}{4}$ she has left is the same as 25%.

70

Understanding Percent Lesson 2: Fractions, Decimals, and Percents
Name: Key   **Date:**
Ticket Out the Door

Show all the necessary work to support your answer.

1. Convert 0.3 to a fraction and a percent.

$$0.3 = \frac{3}{10} = \frac{30}{100} = 30\%$$

2. Convert 9% to a fraction and a decimal.

$$9\% = \frac{9}{100} = 0.09$$

3. Convert $\frac{3}{8}$ to a decimal and percent.

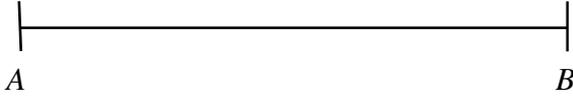$$\frac{3}{8} = 3 \div 8 = 0.375 = 37.5\%$$

Understanding Percent Lesson 2: Fractions, Decimals, and Percents
Name: Key   **Date:**

Homework

Use line segment $\overline{AB}$ to find the answers to **1** and **2**.

A ├────────────────────────────────┤ B

1. If line segment $\overline{AB}$ represents 50%, what is the length of a line segment that is 100%?   **6 inches**

2. If line segment $\overline{AB}$ is 300%, what is the length of a line segment that is 100%?
1 inch

3. Draw a picture to fine each percent.

     a. $\frac{3}{4}$ **75%**

     b. $\frac{4}{5}$ **80%**
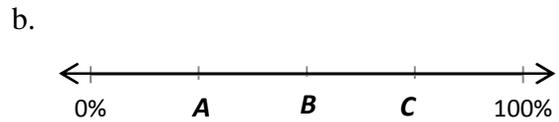
     c. $\frac{13}{20}$ **65%**

4. Each line segment below represents 100%. Estimate the percents that points A, B, and C represent.

    b.   b.

0%   A   100%   0%   A   B   C   100%

      A is about 50%.   **A is about 25%, B is about 50%, and C is about 75%**

72

Understanding Percent Lesson 2: Fractions, Decimals, and Percents Homework

5. **Writing to Explain** Jamal said that he could write a percent as a decimal by moving the decimal point two places to the left and deleting the percent sign, is he correct? How do you know? Give an example.

I know that 50% is equivalent to 0.50. So in my example I would remove the percent sign and write 50 as a decimal like so 50.0. If I move the decimal two places to the left then I would get the decimal 0.50. Therefore, Jamal is correct. When converting from a percent to a decimal I can move the decimal two places to the left and remove the percent sign.

6. **Number Sense** Two stores sell their goods at the manufacturers' suggested retail prices, so their prices are the same. Which store has the greatest markdown from their original prices?

30% off

$$\frac{1}{4} = 25\%, 30 > 25$$

Buy and Bye has the greatest markdown.

7. Make flash cards with one side the percent and the other side a fraction. Choose either the percent or fraction side and include a diagram or picture model. Use the following benchmark percents: 25%, 75%, 20%, 60%, 50%, 40%, 80%, and 100%.

Understanding Percent Lesson 3: Percent of a Quantity   **Name: Key**
                                                               Date:

Essential Question: How are the part, whole, and percent found?

Warm up: (Example 1-3)
Example 1 **Examples 1-3 partner work and then go over as a whole class**
Five of the 25 girls on Alden Middle School's soccer team are 7th-grade students.
Find the percentage of 7th graders on the team. Show two different ways of solving
for the [   ] answer.
One of   the
methods must include a diagram or picture model.
Method 1

| 0% | | 20% | 40% | | 60% | 80% |
100%

| 0 | 5 | 10 | 15 | 20 | 25 |

Method 2
$$\frac{5}{25} = \frac{1}{5} = \frac{20}{100} = 20\%$$

Simplified Example 1: 5 out of 25 = _____%
                    Part X Whole = Percent

Example 2
Of the 25 girls on the Alden Middle School soccer team, 40% also play on a travel
team. How many of the girls on the middle school team also play on a travel team?
One method: $40\% = \frac{40}{100} = \frac{10}{25}$ *Therefore,* **10** *of the* **25** *are on the travel team.*
Another method: Use of tape diagram shown below.

| 0% | 20% | 40% | 60% | 80% | 100% |

| 0 | 5 | 10 | 15 | 20 | 25 |
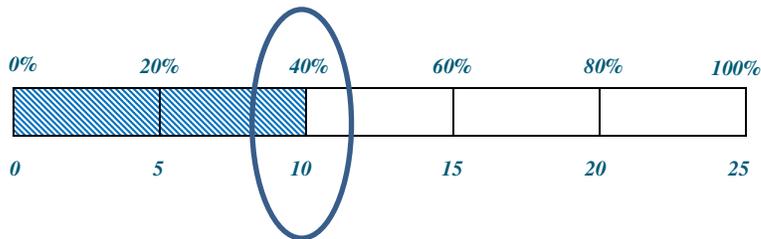
10 of the girls also play on a travel team.
Simplified Example 2: 40% of 25 _____
                    Percent X Whole = Part

Understanding Percent Lesson 3: Percent of a Quantity

Example 3

The Alden Middle School girls' soccer team won 80% of their games this season. If the team won 12 games, how many games did they play? Solve the question using at least two different methods.

Method 1:

$$80\% = \frac{80}{100} = \frac{8}{10} = \frac{4}{5}$$

$$\frac{4 \times 3 \rightarrow}{5 \times 3 \rightarrow} = \frac{12}{15(\textbf{total games})}$$

15 total games

Method 2:

The girls played a total of 15 games.

Simplified Example 3: 80% of _____ = 12

Percent X Whole = Part

Exercise 1

There are 60 animal exhibits at the local zoo. What percent of the zoo's exhibits does each animal class represent?

Exhibits by Animal Class	Number of Exhibits	Percent of the Total Number of Exhibits
Mammals	30	$\frac{30}{60} = \frac{5}{10} = \frac{50}{100} = 50\%$
Reptiles & Amphibians	15	$\frac{15}{60} = \frac{3}{12} = \frac{1}{4} = \frac{25}{100}$ $= 25\%$
Fish & Insects	12	$\frac{12}{60} = \frac{2}{10} = \frac{20}{100} = 20\%$
Birds	3	$\frac{3}{60} = \frac{1}{20} = \frac{5}{100} = 5\%$

Understanding Percent Lesson 3: Percent of a Quantity

Exercise 2
A sweater is regularly $32. It is 25% off the original price this week.
a. Would the amount the shopper saved be considered the part, whole or percent?
Part because the $32 is the whole amount of the sweater, and we want to know the part that was saved.
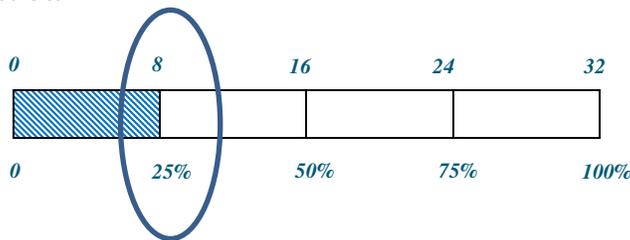
b. How much would a shopper save by buying the sweater this week? Show two methods for finding your answer.
Method 1:

$$25\% = \frac{25}{100} = \frac{1}{4}$$

$$32 \times \frac{1}{4} = \$8 \; saved$$

Method 2:

The shopper would save $8.

Exercise 3
A pair of jeans was 30% off the original price. The sale resulted in a $24 discount.
a. Is the original price of the jeans considered the whole, part or percent?
The original price is the whole.

b. What was the original cost of the jeans before the sale? Show two methods for finding your answer.
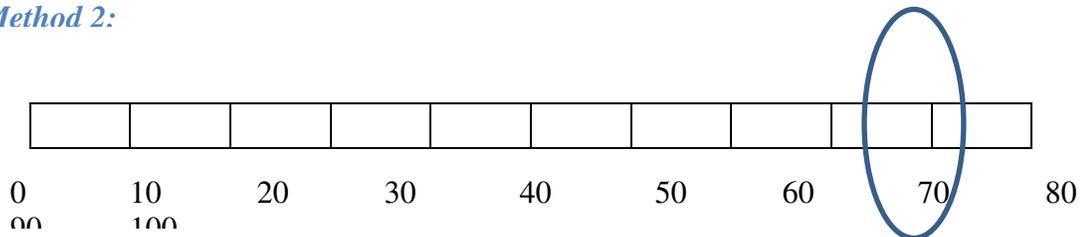*Method 1:*

$$30\% = \frac{30}{100} = \frac{3}{10}$$

$$\frac{3 \times 8 \rightarrow}{10 \times 8 \rightarrow} = \frac{24}{80}$$

The original cost was $80.

Method 2:

Understanding Percent Lesson 3: Percent of a Quantity

Exercise 4
Purchasing a TV that is 20% off will save $180.
a. Name the different parts with the words: PART, WHOLE, PERCENT.

PERCENT	*PART*	*WHOLE*
20% off	$180	Original Price

b. What was the original price of the TV? Show two methods for finding your answer.
Method 1:

0%	10%	20%	30%	40%	50%	60%	70%	80%	

| 0 | 90 | 180 | 270 | 360 | 450 | 540 | 630 | 720 | |
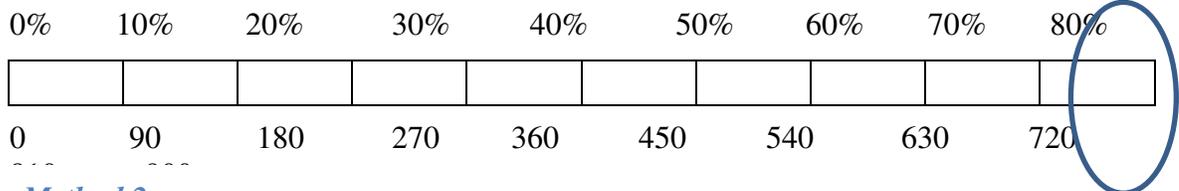
Method 2:

$$20\% = \frac{20}{100}$$

$$\frac{20 \times 9 \rightarrow}{100 \times 9 \rightarrow} = \frac{180}{900}$$

The original price was $900.
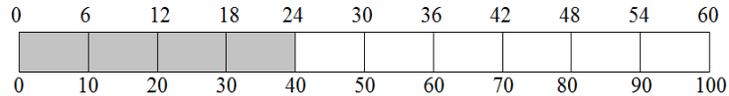
Understanding Percent Lesson 3: Percent of a Quantity   Name: Key
Ticket Out the Door   Date:

1.) Find 40% of 60 using two different strategies, one of which must include a pictorial model or diagram.

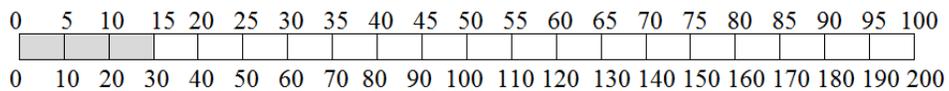*40% of 60*   *40% = $\frac{40}{100} = \frac{4}{10} = \frac{24}{60}$*   *40% of 60 is 24.*

0	6	12	18	24	30	36	42	48	54	60

0	10	20	30	40	50	60	70	80	90	100

2.) 15% of an amount is 30. Calculate the whole amount using two different strategies, one of which must include a pictorial model.

15% = $\frac{15}{100} = \frac{30}{200}$
The whole quantity is 200.

0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100

0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200

Understanding Percent Lesson 4: Solving Percent Problems   Name: Key
                                                                 Date:

Essential Question: How are multistep percent problems solved?

Warm Up:
Exercise 1
Solve the following three problems.

Write the words PERCENT, WHOLE, PART under each problem to show which piece you were solving for.

60% of 300 = _____*180*_____   60% of ___*500*___ = 300   60 out of 300 = ____*20*_%

$$\frac{60\times3}{100\times3} = \frac{180}{300}$$ $$\frac{60\times5}{100\times5} = \frac{300}{500}$$ $$\frac{60\div3}{300\div3} = \frac{20}{100}$$

   PART   *WHOLE*   *PERCENT*

How did your solving method differ with each problem?
Solutions will vary. A possible answer may include: When solving for the part, I needed to find the missing number in the numerator. When solving for the whole, I solved for the denominator. When I solved for the percent, I needed to find the numerator when the denominator was 100.

Understanding Percent Lesson 4: Solving Percent Problems

Exercise 2
Use models, such as 10 x 10 grids, ratio tables, tape diagrams or double number line diagrams, to solve the following situation.

Priya is doing her back to school shopping. Calculate all of the missing values in the table below, rounding to the nearest penny, and calculate the total amount Priya will spend on her outfit after she received the indicated discounts.

	Shirt (25% discount)	Pants (30% discount)	Shoes (15% discount)
Original Price	$44	*$50*	*$60*
Amount of Discount	*$11*	$15	$9

What is the total cost of Priya's outfit?

Shirt $25\% = \frac{25}{100} = \frac{1}{4}$ $\frac{1}{4} = \frac{11}{44}$ *The discount is $11.*

Pants $30\% = \frac{30}{100} = \frac{15}{50}$ *The original price is $50.*

Shoes $15\% = \frac{15}{100} = \frac{3}{20} = \frac{9}{60}$ *The original price is $60.*

The total outfit would cost: $\$33 + \$35 + \$51 = \$119$

Understanding Percent Lesson 4: Solving Percent Problems

Exercise 3

The following items were bought on sale. Complete the missing information in the table. Show your work below.

Item	Original Price	Sale Price	Amount of Discount	Percent Saved	Percent Paid
Television	$1000	$800	$200	20%	80%
Sneakers	$80	$60	$20	25%	75%
Video Games	$60	$54	$6	10%	90%
MP3 player	$86	$51.60	$28.40	40%	60%
Book	$14.00	$11.20	$2.80	20%	80%
Snack Bar	$2.00	$1.70	$0.30	15%	85%

Understanding Percent Lesson 4: Solving Percent Problems   Name: *Key*
Ticket Out the Door   Date:

1.) Jane paid $40 for an item after she received a 20% discount. Jane's friend says this means that the original price of the item was $48.

    a.) How do you think Jane's friend arrived at this amount?

Jane's friend found that 20% of 40 is 8. Then she added $8 to the sale price: 40 + 8 = 48. Then she determined that the original amount was $48.

    b.) Is her friend correct? Why or why not?

Jane's friend was incorrect. Because Jane saved 20%, she paid 80% of the original amount, so that means that 40 is 80% of the original amount

0	20%	40%	60%	80%	100%
0	10	20	30	40	50

The original amount of the item was $50.

2.) The sale price of an item is $160 after a 20% discount. What was the original price of the item?

Because the discount was 20%, the purchase price was 80% of the original

$$80\% = \frac{80}{100} = \frac{160}{200}$$

The original price was $200.

Understanding Percent Lessons 1-4   **Name: Key**
Unit Test Review   **Date:**

Directions: Answer all the questions and show your work. Write answers in complete sentences.

1. What percent of the line segment is shaded?

80%

2. What is 0.4% written as a decimal? **0.004**

3. Most of the U.S. households spend about 5% of their income on entertainment. What fraction of a household's income is spent on entertainment? Write the fraction in simplest form.

$$5\% = \frac{5}{100} = \frac{1}{20} \text{ of a U.S. household's income is spent on entertainment.}$$

4. The world population of cattle, pigs, sheep, and goats increased about 195% from 1961 to 2004. What fraction represents the population increase? Write the fraction in simplest form.

$$195\% = \frac{195}{100} = \frac{39}{20} = 1\frac{19}{20}$$

5. A study found that 9% of dog owners brush their dog's teeth. Of 578 dog owners, about how many would be expected to brush their dog's teeth?

$$\frac{x}{578} = \frac{9}{100}$$

About 60 dog owners are expected to brush their dog's teeth.

6. Paula weeded 40% of her garden in 8 minutes. How many minutes will it take her to weed all of her garden?

$$\frac{8}{x} = \frac{40}{100}$$

20 minutes + initial 8 minutes = 28 minutes
After 28 minutes Paula will have all her weeds taken out.

83

7. The table below shows the distribution of children at an elementary school. If there are 205 children in the school, about how many are in the 5th grade?

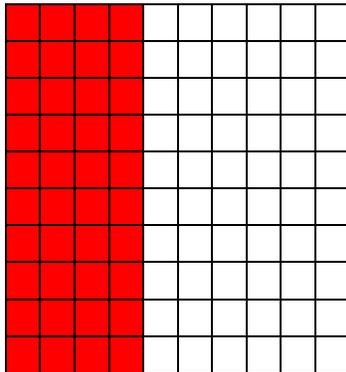| Enrollment by Grade	Percent
1st Grade	19%
2nd Grade	14%
3rd Grade	22%
4th Grade	26%
5th Grade	19%

$\frac{x}{205} = \frac{19}{100};$ **x=38.95**
About 39 students are in the 5th grade.

8. All but 5 state capitals have an interstate highway serving them. What percent of 50 is 5?

$\frac{5}{50} = \mathbf{0.1 = 10}\%$

9. What percent of the grid is shaded?

40%

10. What proportion would you use to find 65% of 28?

$$\frac{65}{100} = \frac{n}{28}$$

11. If 20% of a number is 30, what is 50% of the number? **75%**

12. What is $\frac{7}{25}$ written as a percent? **28%**

13. What is the total amount if the percent is 16% and the part is 48? **300**

14. About 25% of the students at a college are freshmen. Of those, about 50% are women. Does that mean that 75% of the students at the college are freshman women? Explain

No, because only ¼ of the students are freshmen; so 75%, or ¾, could not be freshmen women.

15. Jill walked 6 blocks. This was 25% of her walk. How fare was Jill's walk?
Jill will walk 24 blocks.

16. Evan wants to buy a digital camera that sells for about $200. If he uses his discount car, he will save 18%. He only has $180 to spend.

a.) How much will he save using the discount card?
$200 \times 0.18 = 36$ Evan will save $36 on the digital camera.

b.) How much will the scarf cost Sam?
$200 - $36 = $164
c.) Can Sam afford the belt? Explain **Yes, because after the discount the digital camera is $164 and he has more money than that to spend.**

Understanding Percent Lessons 1-4   **Name: Key**
Unit Test   **Date:**

Directions: Answer all the questions and show your work. Write answers in complete sentences.

1. What percent of the line segment is shaded?

2%
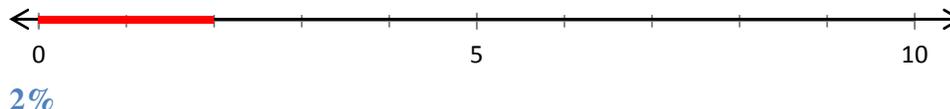
2. What is 68% written as a decimal? **0.68**

3. The muscles in a human body normally account for about 40% of the total body weight. What fraction of the human body is made up of muscles? Write the fraction in simplest form.

$$40\% = \frac{40}{100} = \frac{2}{5} \textbf{ of the human body is made up of muscles.}$$

4. The Earth's crust is about 2% titanium. What fraction of the Earth's crust is titanium? Write the fraction in simplest form.
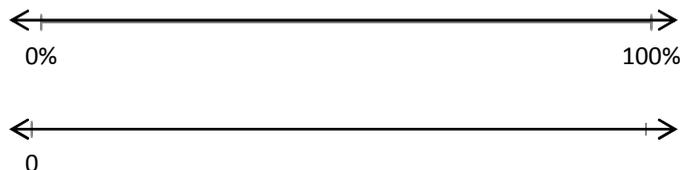
$$2\% = \frac{2}{100} = \frac{1}{50} \textbf{of the Earth's crust is titanium.}$$

5. Scientists estimate that about 14 million species exist, and only about 15% of them have been studied and named. About how many species have been studied and named?

$$\frac{x}{14} = \frac{15}{100}$$

About 2.1 million species have been studied and named.

6. Jan knit 20% of a sweater in 5 days. How many days in all will it take Jan to finish the sweater?

$$\frac{5}{x} = \frac{20}{100}$$

25 days + initial 5 days = 30 days
It will take Jan 30 days to finish the sweater.

7. The table below shows the slope rating of runs at a ski resort. If there are 75 runs total, about how many are most difficult?

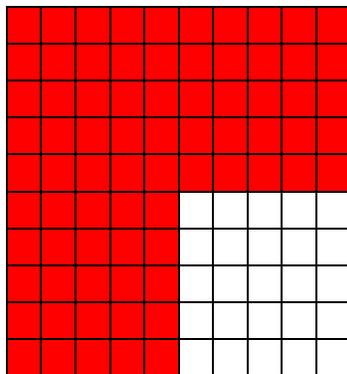| Sun Valley Resort Slope Rating	Percent
Easiest	36%
More difficult	42%
Most difficult	22%

$\frac{x}{75} = \frac{22}{100}$; **x=16.5**
About 17 slopes are rated as most difficult.

8. Trevor got 18 out of 25 problems correct on a math test. What percent were correct answers?

$\frac{18}{25} = 0.72 = 72\%$ **of Trevor's answers were correct.**

9. What percent of the grid is shaded?

75%

10. What proportion would you use to find 95% of 60?

$$\frac{95}{100} = \frac{n}{60}$$

11. If 10% of a number is 8, what is 80% of the number? **64%**

12. What is $\frac{9}{30}$ written as a percent? **30%**

13. What is the total amount if the percent is 32% and the part is 16? **50**

14. About 30% of U.S. households own at least one cat. About 49% of cat owners own exactly one cat and the rest own more than one cat. Does that mean that 81% of U.S. households own more than one cat? Explain

No, because only 3/10 of U.S. household own at least one cat. About 49% of the 3/10 own exactly one cat. Therefore, 81% of households do not own more than one cat.

15. Danny has 6 orange-colored shirts. This is 40% of the shirts he owns. How many shirts does Danny own? **Danny owns 15 shirts.**

16. Sam is shopping at Calvin Klein where there is a storewide sale of 25% off. She only has $25 of her allowance money to spend and Sam wants to buy a belt that originally costs about $40.

a.) How much money will Sam save with the sale?

Method 1

$$25\% = \frac{1}{4}; 0.25$$

0%	25%	50%	75%	100%
0	1/4	2/4	3/4	4/4
0	0.25	0.50	0.75	1

| 0 | 10 | 20 | 30 | 40 |

Method 2

$$\frac{x}{40} = \frac{25}{100}$$
$$x \times 100 = 40 \times 25$$
$$\frac{100x}{100} = \frac{1000}{100}$$
$$x = 10$$

Same will save $10.

b.) How much will the scarf cost Sam with the sale?
$40 - $10 = $30
After the sale the scarf will cost Sam $30.

c.) Can Sam afford the belt? Explain **No, because the scarf will cost Sam $30 and she only has $25 which is less than $30.**