Integrating Math into ESOL Units:
A Math Packet for ESOL Teachers

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Shopping

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Math and language are part of our daily activities. When we make a purchase, cook, exercise and take public transportation, we are using math. In many ESOL course books, math topics are included in thematic units such as shopping, banking, and food. Some books might ask students to tally a bill, write a check or create a budget, but ESOL course books generally don't deconstruct the math concepts needed for those tasks.

Understanding math is so much more than memorizing math rules. Think about how you mentally total a bill or calculate sales tax. It is likely that you use different strategies depending on the situation. The math we encounter involves understanding math concepts and how they are related, selecting strategies for problem solving and making sense of math procedures and when to apply them.

In response to ESOL teachers who would like to integrate math in their language classrooms, the SABES Mathematics and Adult Numeracy Curriculum & Instruction PD Center at TERC is developing a set of Math Packets for ESOL Teachers. Each packet will include a series of language lessons that integrate math. The math activities are designed to dig deeper into math topics and provide the building blocks that teach the skills and knowledge our learners need to understand the underlying math concepts.

Each ESOL Math Packet will include:

- Background knowledge for the teacher
- Prior knowledge needed by learners
- Language tasks
- Activities that allow learners to explore math concepts
- List of materials needed
- Instructional strategies including ideas for differentiating for math abilities
- Assessments

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Lesson 1
Topic: U.S. Currency

Rationale

Identifying U.S. currency and writing its numerical representation is a task found in many ESOL course books. However, the ability to speak and write vocabulary is only one step in being able to use money for life skills such as completing purchasing transactions. In this lesson, you will have the resources to move your students beyond this first step by combining language and math to explore the underlying math concepts that each of us employs when using money. These concepts are:

- number sense: place value, estimation strategies, and operations
- decimal fractions
- proportional reasoning
- data and graphs
- measurement

Background

In many cultures, the use of commas and decimal points is the opposite of standard U.S. math notation. In other words, we use a *decimal point* to separate dollars and cents ($300.21) while many other countries use a *comma* to separate these numbers ($300,21).

Along the same idea, we use a comma to separate digits in larger numbers to make them easier to read (432,000.00) while other countries use a decimal point to separate larger numbers (430.000,00).

Here is another example. For the amount "thirty-one thousand, four hundred dollars, fifty-seven cents",

in the U.S. we write:	in some other countries, they write:
$31,400.57	**$31.400,57**

(For more information on how math notation differs in other countries, we suggest the free PDF resource *The Answer is Still the Same… It Doesn't Matter How You Got It!*: *A Comparison of U.S. and Other Computation Methods for Math Teachers and Students of Various Backgrounds*.)

In this lesson, as your students write math sentences, note who uses a comma rather than a decimal point to separate dollars and cents. This is an opportunity for students to share what they know about math notation in their culture and how it is the same or different from standard U.S. notation. Allowing students to use language to talk about math provides an

authentic communication context and gets students used to sharing what they know about math and numeracy.

Topic: U.S. Currency	
ESOL Task	• Recognize and label U.S. currency • Aural comprehension and verbal production of currency amounts • Read and write math sentences
Math Concepts Addressed	• Number sense • Place value • Operations
Materials Needed	• Piles of play money – enough for each student to have at least one of each coin (pennies, nickels, dimes, etc.) and a few bills of various denominations. • Optional: Sets of picture cards with objects for purchase
Vocabulary list of math terms	*penny* *one cent* *dime* *nickel* *one-dollar bill, five-dollar bill, etc.* *add, subtract, plus, minus, equal to*
Introduction / Warm Up	As students enter the class, they complete sentences. For example: *With $1.00, I can buy _____.* *With $5.00, I can buy _____.* *With $20.00, I can buy _____.* *With $100.00, I can buy _____.* **<u>Strategies for Differentiation</u>** **More accessible:** • Provide picture cards for objects that can be purchased. **More challenging:** • Students can create sentences with different currency amounts. • More advanced students can use mixed numbers, for example: $20.75.
Activities	1a. Write a few math sentences on the board and elicit how to say them. Review symbols for operations as needed: (+), (–), (=), etc. and elicit the math operation they represent (addition, subtraction, multiplication, division) and how we say the operations in a math sentence or equation, for example: We write: *1 + 1 = 2.* We say: *1 plus 1 equals 2* or *1 plus 1 is 2.*

	1b. Students write their own math sentences and give them to a partner to read aloud. 2. Using the same pile of coins and bills in the middle of the table, write an amount on the board (for example, $1.25) and ask students to select coins to equal that amount. Model with several different amounts. **Note:** Show how cents are sometimes written without a decimal point: 5¢, 10¢ 3. Pair students. Each student takes turns saying or writing an amount of money on a piece of paper and the partner selects coins/bills to equal that amount. Students describe their partner's combination. **Strategies for Differentiation** **More accessible**: • Provide cards with dollar amounts. Students can state the combinations in simple terms, for example: *Five cents plus five cents is/equals ten cents.* **More challenging:** • Students can create sentences with past tense verbs, for example: *She added five cents and five cents to equal ten cents. Then she added…* **Extending the activity:** Select amounts and ask: *What is the fewest number of coins you could use to get this amount?*
Assessment	**Show me the money** 1. Put a pile of play money in the middle of the table and say to students: *Show me $2.50* *Show me $1.27.* **Note:** Use three and four digit numbers (such as $435.78 or $1,289.00) for more advanced students. 2. Dictate currency amounts and students write the amount on a piece of paper or small white board.
Additional Resources	• *The Answer Is Still the Same… It Doesn't Matter How You Got It!* https://www.sabes.org/sites/default/files/resources/The_Answer_Is_Still_the_Same_2020.pdf • *New World Encyclopedia: Decimal* http://www.newworldencyclopedia.org/entry/Decimal • *Math Notation in Other Countries* https://www.csus.edu/indiv/o/oreyd/acp.htm_files/todos.operation.description.pdf

Lesson 2
Topic: Place Value

Rationale

Do you ever stand in line at the cash register and mentally estimate the total amount of your purchase? If so, pause to think about the strategies you use. Do you round up to the nearest dollar or ten dollars and mentally keep a running total? Or maybe you add all the items that are about one dollar and then those that are closest to five dollars, etc. and keep a running total?

There is no correct way to estimate in this scenario. At school, most of us learned rules like rounding up (five or more) and rounding down (four or less), but in real life, we don't normally apply those rules. We use the strategy that best fits the situation. In the case of shopping, we round up because we want an idea of the total and either want to make sure we have enough cash or simply want to know the most our purchase should be. (Although if we stepped on a scale to weigh ourselves, we might choose to round down!)

The math concepts we are employing are number sense, place value, operations, and estimation strategies. Wow! That's seems like a lot of math. Let's look at how we can make these math concepts transparent to our students so they have the confidence to use these skills when they need them.

Background

Our number system is a decimal system. The prefix *deci-* in the metric system is of Latin origin and means one-tenth of a measurement unit. In our U.S. number system, *decimal* refers to our **base ten number system**. That means that each new place value is created with ten groups of the previous place value. For example, ten groups of 100 gives us 1,000; ten groups of 1,000 gives us 10,000, and so on.

What this means is that **every time we move one place value to the left, the next place value is ten times larger**. Let's look at the number 111 as an example:

1	**1**	**1**
hundreds	tens	ones

If we move to the right of the decimal point, to numbers less than 1, we encounter the opposite. **Each time we move one place to the right, the next place value is ten times smaller.** Note the place value of ten cents (.10) and one cent (.01). One cent is one-tenth of ten cents.

1	**1**	**1**	**.1**	**.01**
100	**10**	**1**	**.1**	**.01**
hundreds	tens	ones	tenths	hundredths

Our ESOL students need to recognize the difference between the whole number *ten* (10) and the fraction, *one-tenth* (1/10). The challenges our learners often have are:

- aural discrimination between ten and tenth, four and fourth, etc.
- visual discrimination between 1.0, .10, and .01.

In this lesson, we will focus on the role of place value in estimating currency amounts.

Topic: Place Value	
Prior Knowledge	• Students are able to recognize most U.S. currency (coins and bills) and state the amount each represents. Example: *A nickel is worth five cents.* • Students are able to add and subtract 2-digit numbers. • Students understand U.S. math notation (see Lesson 1: U.S. Currency).
ESOL Task	• Tally a bill using mental math • Complete a purchasing transaction
Math Concepts Addressed	• Place value • Connections between addition and subtraction
Materials Needed	• Play money (at least one ten- or twenty-dollar bill for each student) • Handout: *Math in Line* • Handout: *Template Place Value Puzzle* • Handout: *Roll, Show, Write* • Handout: *Place Value Game* • Ten-sided dice (three for each pair/small group) (You can also draw numbers out of a bag if dice are not available.) • Store flyers with pictures and prices
Vocabulary list of math terms	*place value* *ones* *tens/tenths* *hundreds/hundredths* *thousands/thousandths* *ten thousands* *digit*
Introduction / Warm Up	Ask students: *Which is bigger: $5.00, .50, or .05?* *How do you know?*
Activities	**I. Introduce place value** Using pictures from flyers, introduce the concept of place value (the value of a number, or digit, changes depending on its place). Elicit the value of the number "3" in each of the prices: $325.00 and $3,500.00. Chances are students know the value of a number changes according to its place within a number. If they struggle to find the words to describe this, write their explanation on the board exactly as they say it and then go back and fill in the sentence with the math terms such as ones and hundreds and then give them the math term: ***place value***.

II. Place value rotation stations
Students rotate to each station to practice the concept of place value. Here are some examples of activities you can use or create.

- Station 1: Place Value Puzzles
  Handout: *Template Place Value Puzzle*
  Using the template provided, students write a number in standard notation, expanded notation and in words.

  More accessible: Write the standard form for students.

  More challenging: Students create their own four- to six-digit numbers.

- Station 2: Roll it, show it, write it
  Handout: *Roll, Show, Write*
  Using dice, students roll two or three die and assemble them to form a number. Next, they complete each column in the handout with a sketch and numerical representation of the number rolled.

- Station 3: Build a number
  http://mathwire.com/numbersense/morepv.html
  Create challenge statements for students. Differentiate the activity by changing the complexity of the task as noted in the activity.

III. A place value game
Distribute the *Place Value Game* handout to each student and give one ten-sided die to each pair of students. Taking turns, the students roll the die eight times and after each roll, place the number that comes up in one of the eight blanks in the top line. After rolling eight times, they should have completely filled in the blanks representing the amount of money they started with and the amount of money they spent. Students then write down something that they could buy equivalent to the amount of money they "spent" in the appropriate blank on the bottom line and calculate the amount of change they would get. The player with the greatest amount of change wins the game.

Strategies for Differentiation

More accessible:

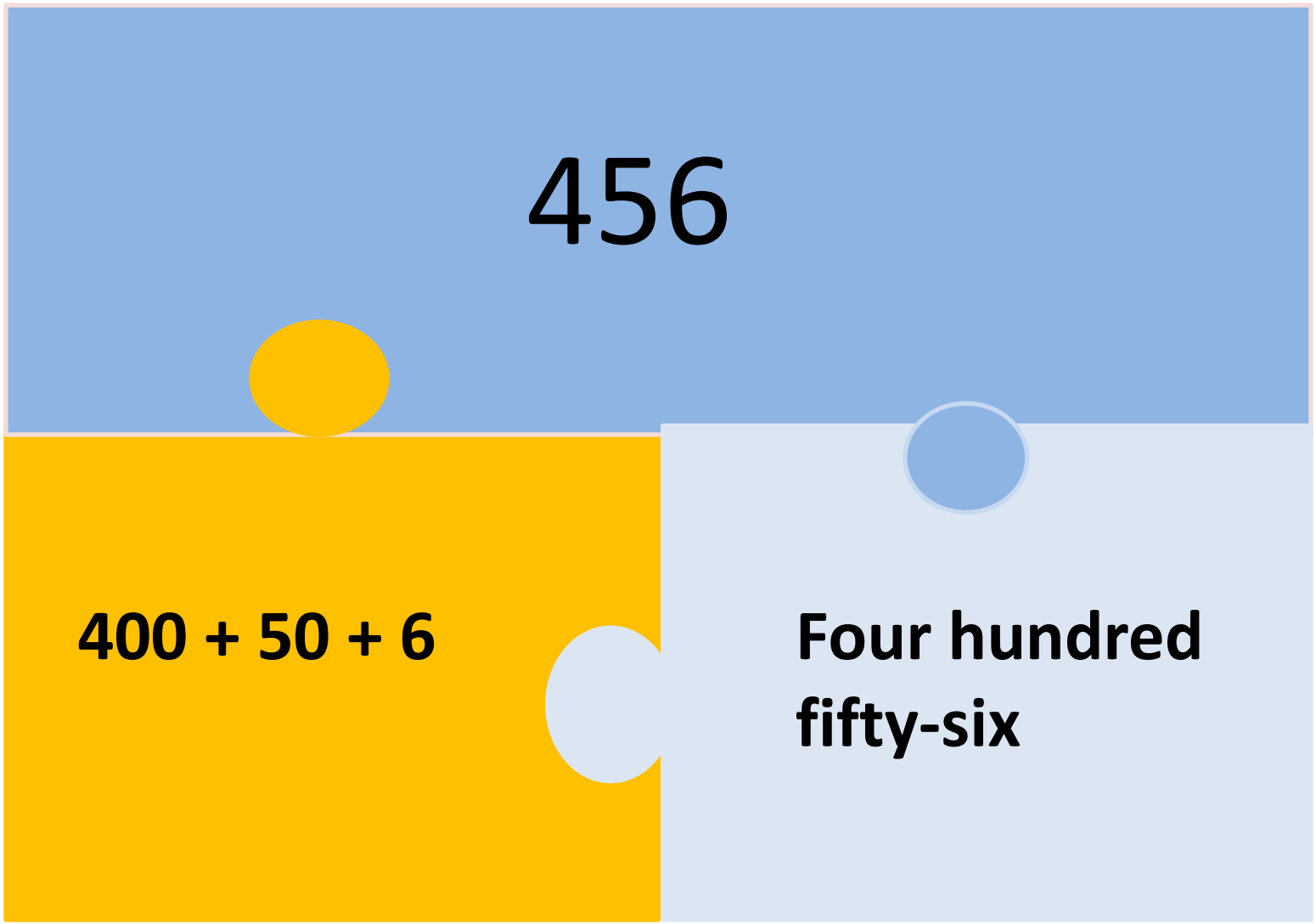
- Allow students to roll the die and collect all eight numbers before deciding which blanks to put them in.

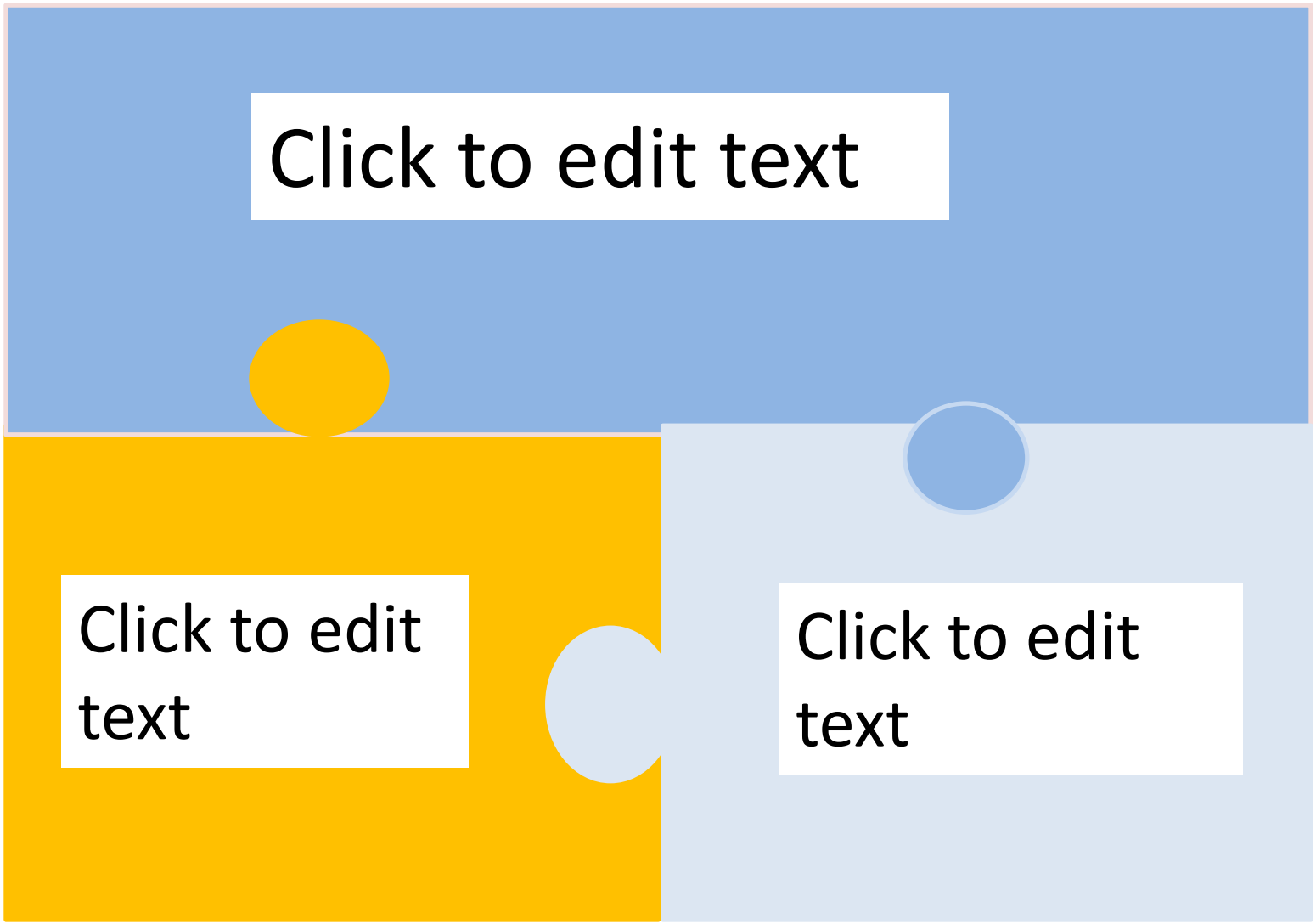
More challenging:

- Mix up which blanks get filled in. For example, have students fill in the amount spent and the change and then figure out how much they started with or have them fill in what they started with and the change and figure out how much they spent.

	Alternative way of playing: Make the game cooperative and have student pairs decide together how to place the numbers in the blanks. **IV. Applying place value in estimation** Using pictures of items in flyers, students round to the nearest dollar, ten dollars, and hundred dollars. **Technology Integration (optional): Using smartphone calculators** This is an opportunity for students to explore the calculator on their phones (or you can give them regular calculators to use). Most calculators have a setting to adjust the number of decimal place to the right of the decimal point. Based on the setting, the calculator will automatically round to the nearest tenth, hundredth, etc. (Consult the manual of the calculator you are using or do an Internet search to find out how to change the setting before beginning this activity. The setting will differ from calculator to calculator.) • Before changing any calculator settings, give students some two-, three- and four-digit whole numbers to add, subtract and multiply. Let them compare the answers on their calculators with a partner. • Next, show them how to change the decimal point setting so that only two decimal places are displayed. • Give students numbers with several decimal places such as 9.345, 7.555, 4.989, etc. Ask them to first predict what the calculator will round each number to if it will only show two decimal places to the right of the decimal point. Students enter the numbers and compare their calculator's number with a partner. **Strategies for Differentiation** **More accessible:** • Use smaller number up to 10 or 100. • Use whole numbers only. • Students use concrete objects such as small and large blocks (such as Base Ten Blocks) to show place value. • Extend the writing and listening with dictation of two-digit prices. **More challenging:** • Use larger numbers. • Use mixed numbers (dollars and cents). **Extending the Activity:** Handout: *Math in Line*
Assessment	**Estimating prices** 1. Give students $200.00 in play money and a few advertisements from

	store flyers of products with prices. Select prices with one-, two-, and three-digit numbers. 2. Ask students to decide if they have enough money by: • estimating each amount by rounding to nearest whole dollar, ten dollars and hundred dollars • adjusting by adding or subtracting to find the exact amount • showing how they figured out the answer
Additional Resources	• *Math is Fun: Decimals* https://www.mathsisfun.com/place-value.html • *Place Value* video https://mathantics.com/lesson/place-value • *Place Value Puzzle* https://www.funbrain.com/games/place-value


456
400 + 50 + 6
Four hundred fifty-six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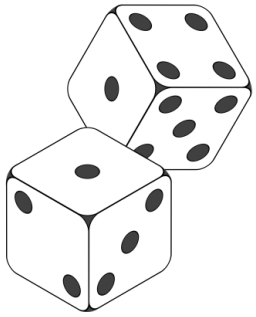
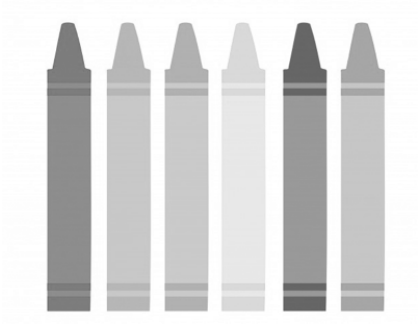
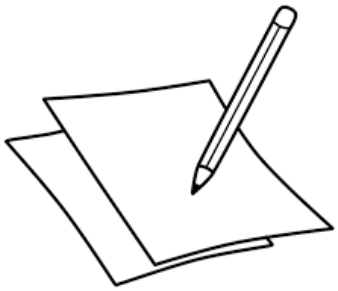
Shopping L2: Place Value
Handout - Roll, Show, Write

Roll	Show			Write		
						
3, 5, 2				**Hundreds**	**Tens**	**Ones**
				3	**5**	**2**

Adapted from original by Chrissy Youel/Adventures in Second Grade @2012

Shopping L2: Place Value
Handout - A Place Value Game

Directions:

Play with a partner. Take turns rolling the die. Put each number that comes up in one of the blanks on the first line. You decide where to put it!

Write what you bought in the blank on the second line.

Calculate how much money you have left. The player with the most money left wins the round.

(If you spent more than you had, you lose!)

Round 1:

I had $___ ___.___ ___ and I spent $___ ___.___ ___ on

(a/an/some) _____. Now I have $___ ___. ___ ___ left.

Round 2:

I had $___ ___.___ ___ and I spent $___ ___.___ ___ on

(a/an/some) _____. Now I have $___ ___. ___ ___ left.

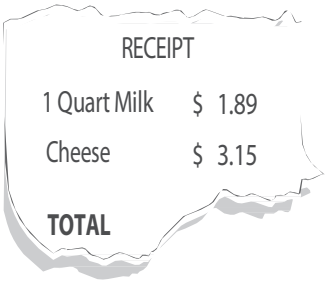
Round 3:

I had $___ ___.___ ___ and I spent $___ ___.___ ___ on

(a/an/some) _____. Now I have $___ ___. ___ ___ left.

Activity 1: Math in Line

1. On the way home from work yesterday, I stopped at the store and bought two items. One cost $1.89 and the other cost $3.15. While I was waiting at the checkout line, I reached into my wallet and realized I only had a five-dollar bill. Did I have enough money for my purchases? How do you know?



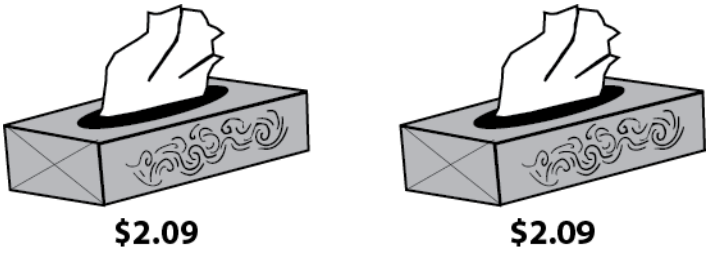
For Problems 2–5, work with a partner. Solve the problems using mental math and then compare your strategies.

2. Sara is in line at the grocery store. She is buying three loaves of bread for $2.98 each. She hands the cashier a $10 bill.

a. Does she have enough money? How do you know?

b. How could she round and then adjust her answer to figure out exactly how much change she will get?

3. Daniel goes to the pharmacy and buys two boxes of tissues for $2.09 each, including tax. He gives the cashier a $5 bill.



a. How much change will he get?

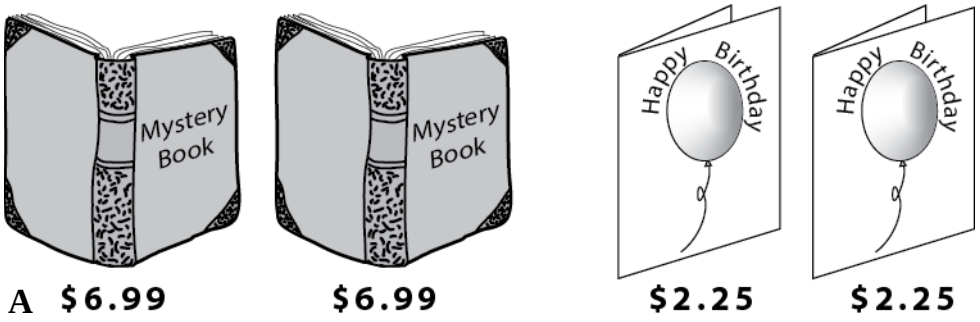
b. Show how you figure out your answer.

4. Jerry spent the day shopping, and his last stop was at a discount department store. He bought four shirts at $6.95 each. He had $25 in his wallet.

a. Did he have enough money to pay for the shirts? How do you know?

b. How could he figure out the exact cost of the shirts in his head?

5. Olga made a quick stop at the drug store. She bought two mystery books at $6.99 each and two birthday cards for $2.25 each. Luckily for Olga, there was no tax, because she had only two $20 bills in her wallet.



a. What did she have in her wallet after making the purchases?

b. Show how your figured out your answer.

Lesson 3
Topic: Number Sense: Connecting the Operations

Rationale

Think back to the last time you made a cash purchase. When you received change back, did you count it or did the cashier count it as she handed it to you? Let's take a look at a common cash purchase transaction:

Cashier: *That will be $9.00.*
(You hand the cashier a ten-dollar bill.)

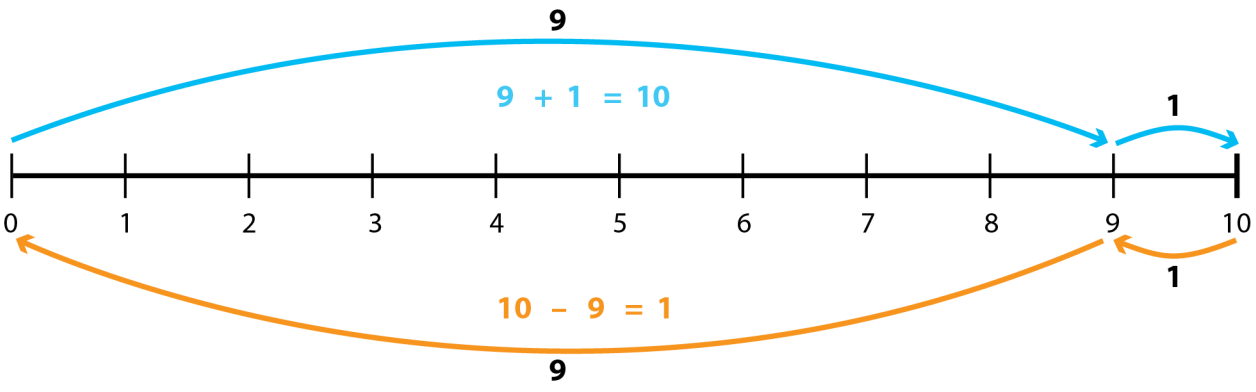
Cashier: *Out of ten – nine and one makes ten.*

Today, cash registers do the work of calculating the amount the cashier needs to give the customer, but it is our job as wise consumers to count the change and confirm it is correct. Look back at the scenario above. What do you notice about the cashier's *thinking* as she counts back the change?

Background

You may have noticed that instead of subtracting (10 – 9 = 1), she has added up (9 + 1 = 10). The four operations (addition, subtraction, multiplication, division) are so tightly related that we use these connections to our advantage without being cognizant of what we are doing and why.

In the scenario above, the cashier is mentally making a connection between addition and subtraction. A number line can provide a visual image of the inverse relationship of addition and subtraction. Regardless of the direction you go – up or down – you are simply **finding the difference between two numbers.**



The notion of counting up includes an understanding of place value. (See Lesson Topic: Place Value). When we count up, we often count up to the nearest one or ten.

There are many ways we make connections among the four operations in our daily activities. Let's take a look at another way this knowledge serves us using the problem below:

> You want to save some money to buy a new TV. You think you can save $50.00 a month. The TV costs $250.00. How many months will it take you to save enough money to buy this TV?

You could solve this problem by looking at the inverse relationship between addition and subtraction: by adding up instead of subtracting. The same is true for division. You can multiply up instead of dividing. You can think about what you would have to multiply to get the original total. In the example above, you could either think about how many 50s would make 250, or you could divide 50 into 250.

Topic: Number Sense: Connecting the Operations	
Prior Knowledge	• Students are able to recognize most U.S. currency (coins and bills) and state the amount each represents. Example: *A nickel is worth five cents.* • Students are able to add and subtract two-digit numbers. • Students understand U.S. math notation (see Lesson 1: U.S. Currency).
ESOL Task	Using a shopping scenario, students create a role play
Math Concepts Addressed	Number sense: connections between the four operations
Materials Needed	• Handout: *Shopping Scenario* • Props for role play (play money, etc.) • Handout: *Math Inspection: The Four Operations* • Handout: *Math Inspection: The Four Operations Answer Key* • Handout: *Number Line Template*
Vocabulary list of math terms	*place value* *count up* *number line* *ones* *tens* *hundreds* *thousands* *ten thousands* *digit*
Introduction / Warm Up	Give students this scenario: *You buy a coffee at Dunkin Donuts. The coffee costs $_____.* *You give the cashier $5.00. She gives you change.* *How do you know if you have received the correct change?* There's no one correct answer to this question. Students may respond that they don't count the change they receive. That's OK. It is likely that some students will report counting **up** from the cost of the coffee to $5.00 and others will subtract by counting down.
Activities	**Role play: Shopping transaction** Students will discuss a shopping scenario, then write a dialogue between a cashier and a customer. 1. Use the *Shopping Scenario* handout provided (or create your own). This is an open word problem. Students will work together to decide

	the gift they are going to buy and the amount they want to spend. 2. As students do the math, note what operations students use for calculations. You may notice some students use addition, and others use multiplication, division, or subtraction. **Key strategy:** Select students with different approaches and ask them to share with the rest of the class. 3. Elicit why the different approaches work and start writing the connection on the Handout: *Math Inspection: The Four Operations*. You can create this as a poster and students can add to it throughout the year using numbers, equations, sketches, or words. 4. Using their role play script, students perform the shopping transaction in pairs. **Technology Integration (optional): Using Google docs for collaboration and communication** Students can work collaboratively on the dialogue using Google docs. As they create shopping dialogues, you can see their work in real time, monitor their work online and send them feedback, ask questions, or give prompts directly in the document as a comment or suggestion. The timely feedback will help to improve their writing. **Strategies for Differentiation** When student create their own role play conversations, they will create the dialogue using language they know. Offer vocabulary as needed. **More accessible**: • Scaffold the role play with blanks for students to fill in. • Use smaller numbers. **More challenging:** • Have students write and role play their own shopping scenario.
Assessments	**Option A:** Use the *Number Line Template* provided or create your own. The number line can be in increments of 1 (1 through 10), or 10s (10, 20, 30, etc.). Students fill it in with numbers and use arrows or equations to show two different ways to find the difference between two numbers on their number line (counting up and counting down). Refer to the example in the *Background* of this lesson. They can refer back to the shopping scenario or choose create their own scenario. **Option B:** Give students a copy of the *Math Inspection: The Four Operations* handout. Students write, draw or give examples of any of the connections among the four operations. Students explain their chart to a classmate.

Additional Resources	• *Number Sense: the most important mathematical concept in 21st century K-12 education* https://bit.ly/2MDY9Bi • Jo Boaler clip on number sense https://www.youtube.com/watch?v=Jeel4Qjow4s • *What is number sense?* https://www.gsacrd.ab.ca/download/10268

Shopping L3: Number Sense
Handout - Shopping Scenario

Your friend is having a birthday. You and 3 other friends are going to buy her a gift.

You know she likes _____ and you want to spend approximately $ _____. If the gift costs $_____, each person will spend $ _____.

Write a conversation between you and the cashier at the store. Here is an example:

Cashier: Hi, how are you today?

You: _____

Cashier: Will that be cash or credit?

You: Cash, please.

Cashier: Ok. That will be $ _____

You: Here's $ _____

Cashier: Out of $_____. (She counts the change back to you).

You: Oh, you made a mistake. The price is $_____ and you gave me $ _____ (count the change back to the cashier).

Cashier: Oh, you're right. Sorry about that. Here you go. That's $ _____.

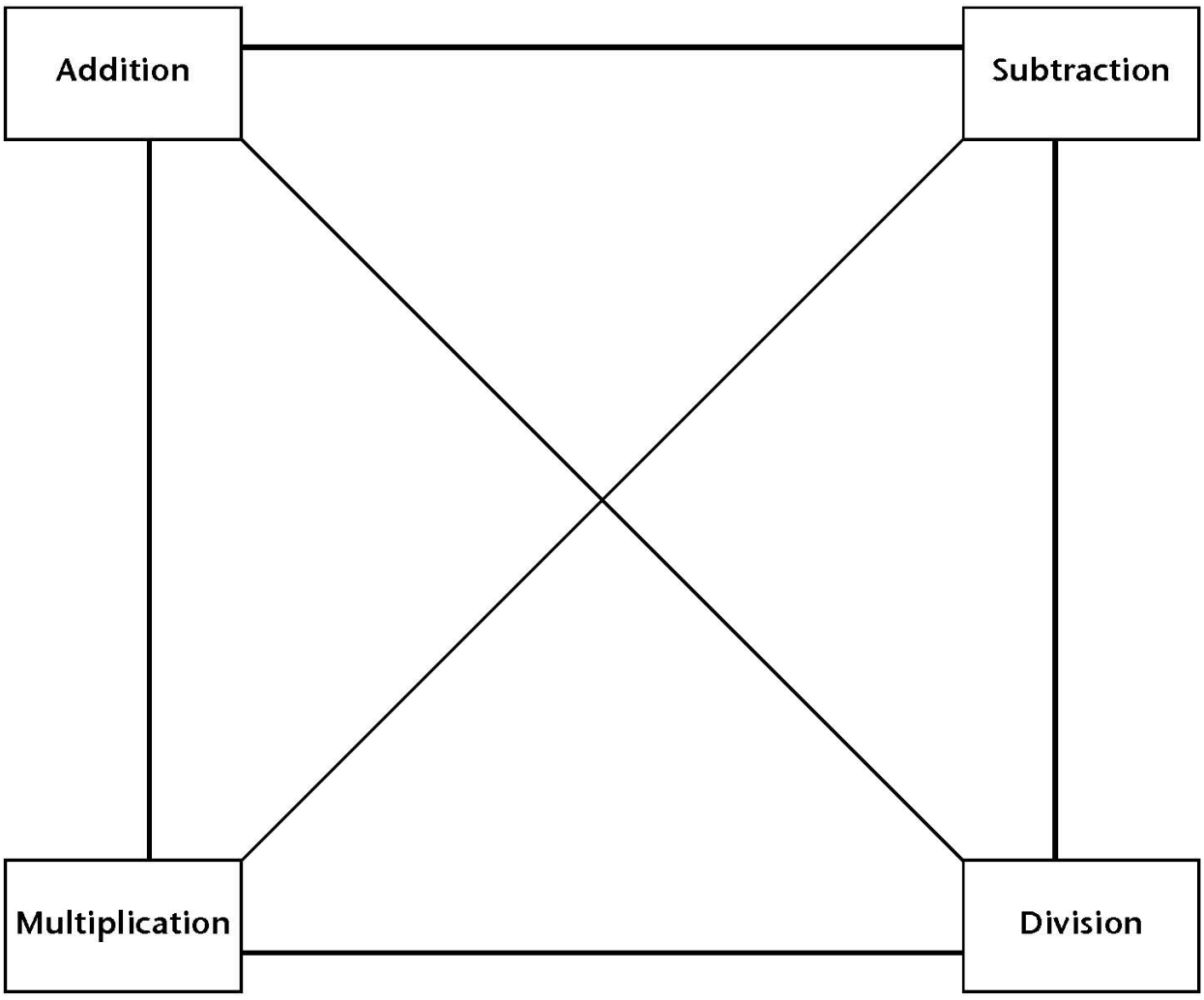
You: Thank you. Have a nice day.

Cashier: You too.

Math Inspection: The Four Operations

1. In your own words, write your understanding of each of the four operations.

2. Then, on the connecting line below, describe all the relationships that the operations have with one another. Give examples.



Shopping L3: Number Sense
Handout - The Four Operations Answer Key

1. Some possible answers:

   - **Addition:** combining, totaling
   - **Subtraction:** comparing, distance between, take away
   - **Multiplication:** repeated addition, area, proportional relationship (rate)
   - **Division:** sharing, fitting one number into another, repeated subtraction, part to whole comparison, ratios

2. Some possible answers:

   Addition to Subtraction:

   - Addition and subtraction are inverse operations: they "undo" each other. For example, 5 + 4 = 9 and 9 – 4 = 5.
   - Subtraction is "adding the opposite": for example, 5 – 6 = 5 + -6 .
   - Adding or subtracting 0 gives the same result.

   Addition to Multiplication:

   - Multiplication can be thought of as repeated addition. For example, 5 x 3 = 5 + 5 + 5.
   - Both multiplication and addition are commutative, meaning the order doesn't matter. For example, 4 x 5 = 5 x 4 and 3 + 4 = 4 + 3 .
   - Both multiplication and addition are also associative, meaning the grouping doesn't matter. For example, 4 x (5 x 6) = (4 x 5) x 6 and 1 + (2 + 3) = (1 + 2) + 3 .
   - Multiplication can be distributed over addition. For example, 2 (3 + 4) = 2 x 3 + 2 x 4.

   Multiplication to Division:

   - Multiplication and division are inverse operations: they "undo" each other. For example, 9 x 4 = 36 and 36 ÷ 4 = 9.
   - Division is "multiplying by the reciprocal." For example, 50 ÷ 2 = 50 x $\frac{1}{2}$.
   - Multiplying or dividing by 1 gives the same result.

   Subtraction to Division:

   - Division can be thought of as repeated subtraction. For example, 20 ÷ 5 = 4 because 20 – 5 – 5 – 5 – 5 = 0.
   - Order matters in both subtraction and division. For example, 3 – 2 ≠ 2 – 3 and 20 ÷ 5 ≠ 5 ÷ 20 .

Shopping L3: Number Sense
Handout - The Four Operations Answer Key

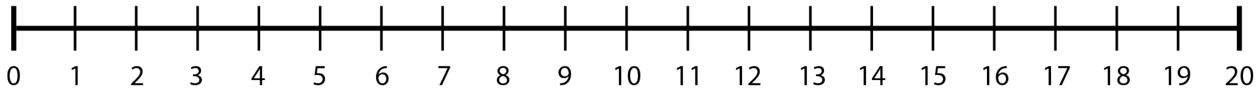
Multiplication to Subtraction:

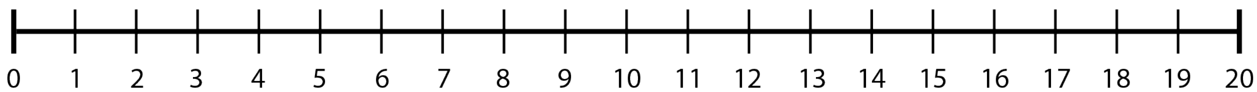
- Multiplication can be distributed over subtraction. For example, 2 (10 – 4) = 2 x 10 – 2 x 4.
- Both multiplication and subtraction are used to compare magnitudes, although in different ways. 12 – 3 = 9 shows us that 12 is 9 more than 3. However, 3 x 4 = 12, which means that 12 is also 4 times as large as 3.

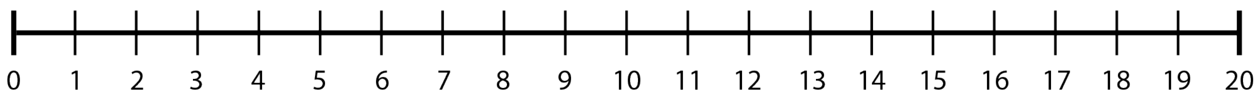
Addition to Division:

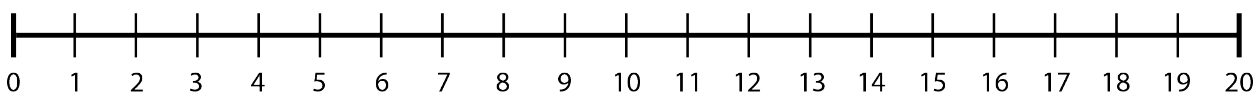
- Addition can be used to find how many of a number "fit" inside another number. For example, 3 + 3 + 3 + 3 = 12 shows us that four 3's fit in 12, therefore 12 ÷ 3 = 4 .

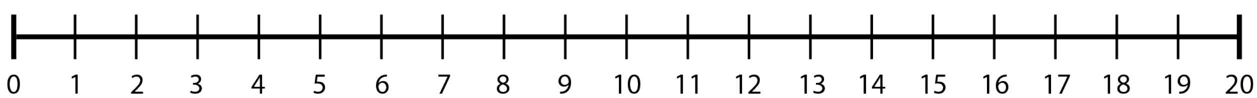
Shopping L3: Number Sense
Handout - Number Line Template

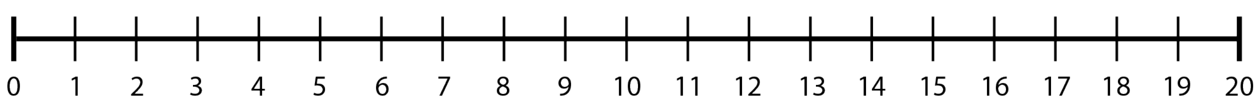




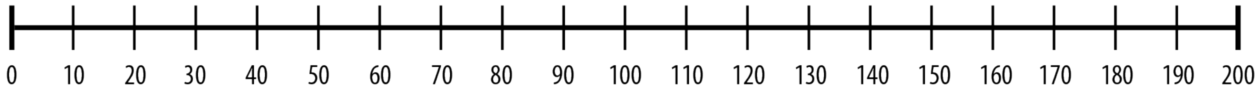


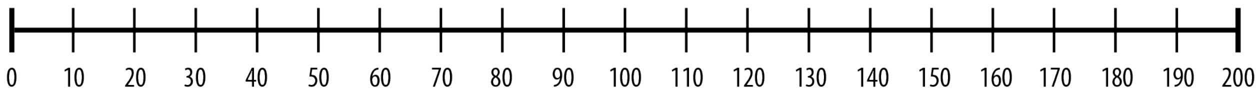


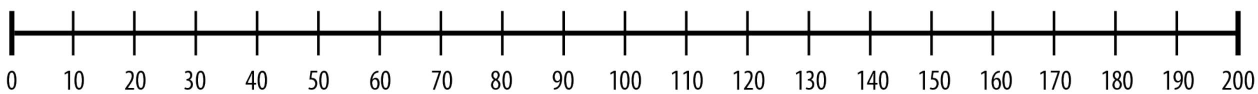


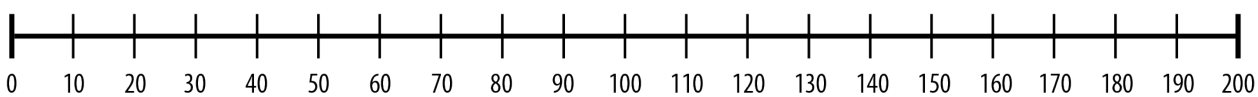


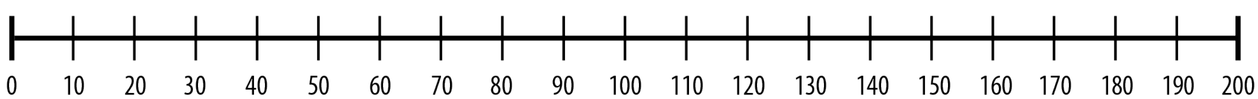
Shopping L3: Number Sense
Handout - Number Line Template

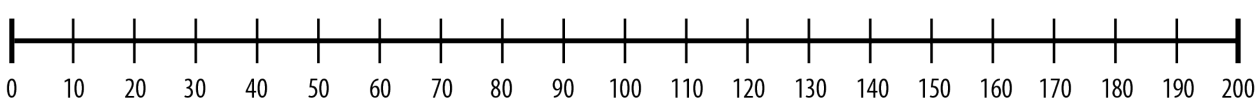




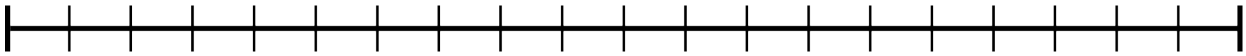


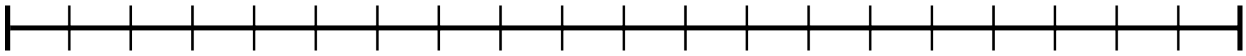


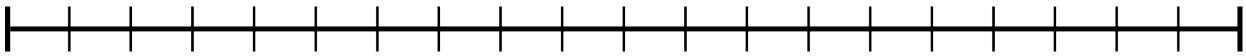


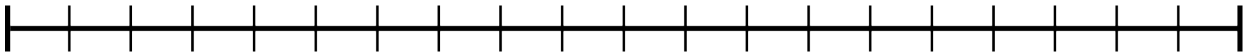


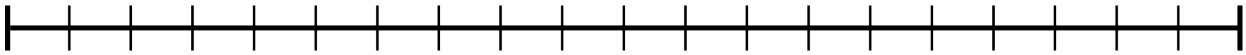
Shopping L3: Number Sense
Handout - Number Line Template

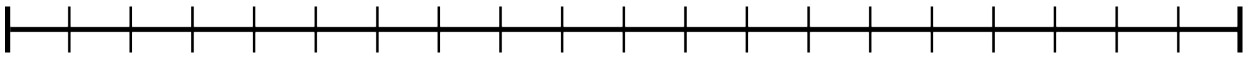












Lesson 4
Topic: Benchmark Fractions, Decimals, and Percents

Rationale

As consumers, we are inundated with media advertisements for sales and best buys. Think about a sales promotion in a flyer: *1/2 off the original price or get an additional 50% off when buying the larger size!* We encounter these situations daily and need strategies to be able to quickly compute what the sales price will be, how much money we will save, or how much more product we are buying if something is 50% more.

Our learners face the same challenge. In addition to interpreting language, they want to understand the math so they can make informed decisions.

Background

Benchmark numbers such as 1/2, 1/4, and 3/4 are numbers that are easy to visualize and calculate and can be used as reference points against which to estimate the size of less familiar numbers. The advantage of using benchmarks is that they are accessible to ESOL teachers and learners at varying levels of math competence, and mirror what numerate adults do with fractions, percentages, and decimals in their everyday life.

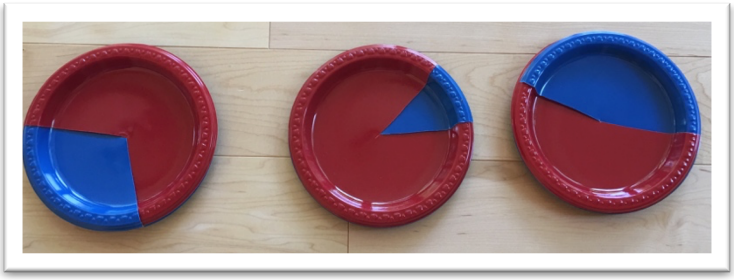
Before students are taught operations with fractions, percentages, and decimals they should:

- have a strong conceptual understanding of what these numbers mean (part/whole) and understand how they connect to one another
- be able to visualize what they look like (visual models)
- use benchmarks to understand less familiar numbers
- know the three different ways to represent benchmark numbers: fraction, decimal, and percentage

In many math textbooks fractions, decimals, and percentages are each treated separately as if they were completely unrelated concepts. However, all three are actually different ways of representing the same amount. Just as languages have synonyms, the language of math has different forms of representation, which may be more or less useful depending on the situation.

Students usually know what 1/2 and 1/4 look like. They probably know one or more of the representations, but often they don't make the connection between the fraction, decimal, and percentage forms. For example, they may know that 1/2 is equivalent to 50%, but they may not make the connection to .50, or they know 1/4, but don't realize this is also 25%. This is one reason why we hear so often from adult learners that fractions, decimals, and percentages confuse them.

Topic: Benchmark Fractions, Decimals, and Percents	
Prior Knowledge	• Students are able to recognize most U.S. currency (coins and bills) and state the amount each represents. Example: *A nickel is worth five cents.* • Students are able to add and subtract two-digit numbers. • Students understand U.S. math notation (see Lesson 1: U.S. Currency).
ESOL Task	Read and interpret store advertisements to determine the best value
Math Concepts Addressed	• Benchmark fractions, decimal fractions, and percentages • Using benchmarks numbers to reason about less common numbers
Materials Needed	• Play money • 7" diameter paper plates (2 different colors) • Colored construction paper cut into 1" x 11" strips (4 strips per student) • Plastic document protector sheets (1 per student) • Teacher Resource: *Consumer Awareness and Financial Literacy* • Handout: *Store A – Sample Reasoning* • Handout: *Practice Reasoning with Benchmarks* • Handout*: Fraction Strip Word Problems*
Vocabulary list of math terms	*part* *whole* *decimal* *fraction* *decimal fraction* *percentage*
Introduction / Warm Up	**Which is the better deal?** 1. Use the *Consumer Awareness and Financial Literacy* advertisements or create your own set of advertisements that use different wording or representations with discounts of 1/2 off the regular price. For example, use one ad with 1/2 off and another that says: *Buy 1, get 1 free* for the same product. 2. Ask students to think about which is the better deal and do some math if they wish, but they should not yell out the answer. As students work, walk around and monitor their work. Look for different approaches to solving the problem. 3. When all students have had enough time to think about the problem, elicit the response which should be: *They are the same deal*. Then ask: *How do you know?* 4. Throughout this activity, note students who have different strategies. **Don't skip this step!** Later in this lesson, you will want to highlight different approaches to finding one-half.

Activities	**I. Looking at equal parts** Start with 1/2. Students need to understand that half, or 1/2 means two equal parts. In the first activity, students use currency to create one-half by creating two equal parts. • Using play money, ask students to show you half of a dollar. They might use 2 quarters, 5 dimes, etc. Then ask them, *How do you know?* Next ask them to write the amount on a piece of paper or a small white board. Look for different representations: .50, 1/2, 50%. 50¢. If not, ask if there are different ways to write the number. • Change the amount to eighty cents (.80) or any amount that divides evenly and again, ask them to show you half of that amount. Each time asking: *How do you know?* **Extending the Activity** Give students concrete objects to show one-half as two equal parts. • Option 1: Using a loaf of bread, a cake, or a cookie ask students to divide the item into halves. • Option 2: Using two paper plates of different colors, cut each paper plate halfway to the center and fit together (see photo). Students manipulate the plates to show one-half.  **Key strategy:** As students illustrate halves with one or more of the activities above, listen for reasoning about equal parts. If they don't come up with it ask: *What do you notice about the 2 parts? How are they the same?* Be explicit that 1/2 means one of two **equal parts.** **II. Finding one-quarter from one-half** • Repeat above for 1/4. (Listen for reasoning of four equal parts.) You can start with one dollar or choose a different amount such as eighty cents. Use numbers that divide evenly. • You can use the paper plates or bread, etc. to show 1/4 or create a drawing. Remember to point out the different representations: 1/4, 25%, .25 and 25¢.

III. Building a conceptual understanding of the relationships between 1/2, 1/4, and 1/8.

In this activity, students will create fraction strips as visual aids for the relative size of fractions, equivalent fractions and the relationship between 1/2, 1/4, and 1/8. The value of this activity is having students create their own fraction strips.

- Refer to *Equal Measures* (Lesson 6, pp. 67-74) in the *EMPower Plus: Using Benchmarks: Fractions and Operations* teacher book for this activity (Or, you can go to websites such as http://illuminations.nctm.org/Lesson.aspx?id=1724 to learn how to create and use fraction strips.) You will cut the strips of paper ahead of time, but be sure to let the students do the folding and labeling of the strips. In folding the strips, students discover that half of 1/2 is one-quarter and half of one-quarter is one-eighth. So each time they double the paper strip, the fraction is half the size of the previous one.

Extending the activity

- The fraction strips are visual aids to calculate parts (discounted amount), percentages and the original price. Using the sample advertisement provided in the handout *Consumer Awareness and Financial Literacy*, ask students to use the play money together with the fraction strips to show which is the lower prices and explain their reasoning. See example provided on the handout *Store A – Sample Reasoning*.

Note: This activity similar to a strategy known as *bar modeling, tape diagrams,* or *Singapore strips*. Refer to the Additional Resources section for more information and practice.

IV. Using fraction strips to calculate discounts

Using an ad for 1/4 or 25% off, students use fractions strips to show:

- The original or regular price
- The amount of the discount (how much money is 25%)
- The sale price

V. Using benchmarks to make sense of less common numbers

- Using the handout *Reasoning with Benchmarks Practice*, students will use their knowledge of 50% and 25% to estimate the amount of a 40% discount.

Additional practice: Reasoning with benchmarks

- *EMPower Plus: Using Benchmarks, Fractions and Operations* (student book), pp. 9, 17, 37, 55

	Strategies for Differentiation **More accessible:** • Use two-digit numbers. • Stick to 1/2 and 1/4. **More challenging:** • Extend to 1/10. • Extend to 1/3, 1/6, 1/12 by preparing new fraction strips for students. • Use three- and four-digit numbers (hundreds or thousands). • Use mixed numbers. • Extend to adding and subtracting fractions using the handout *Fraction Strip Word Problems.*
Assessment	Students create their own shopping discount advertisement using colored pencils, paper, drawings, magazine images, etc. Underneath the ad, students use bar modeling to show: • the original price • the fractional parts of the whole • the part that represents the discount • the amount of the discount
Additional Resources	• *Thinking Blocks Fractions* http://www.mathplayground.com/tb_fractions/index.html • *Decimals, Fractions, and Percentages* https://www.mathsisfun.com/decimal-fraction-percentage.html • *Singapore Math Bar Model Strategy* (practice bar modeling) https://www.youtube.com/watch?v=87j2za5McnI • *Fractions Are Parts* video https://mathantics.com/lesson/fractions-are-parts • *EMPower Plus: Using Benchmarks: Fractions and Operations* (teacher and student books). (2015). BW Walch.

You have $100.00 to buy shoes for your family. Look at the advertisements below. Which store offers a better deal for your family? How did you decide?

Store A

YEAR END SALE!!!
Buy one and get 50% off second pair!
(All shoes $40.00 first pair)

Store B

YEAR END SALE!!!
25% off all items!
(Originally $28.00/pair)

Advertisement #1

Sneakers: Originally $28.00

25% off

$28.00			
$7.00	$7.00	$7.00	$7.00
25%	25%	25%	25%

Reasoning:

25% or ¼ of 28 is 7.

$28.00 - $7.00 = $21.00

Final price is $21.00

Advertisement #2

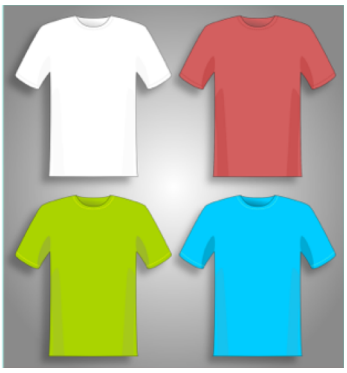
SALE

Buy 1 pair, Get 2nd pair 50%

Shopping L4: Benchmark Fractions, Decimals and Percents
Handout - Practice Reasoning with Benchmarks

Today only

All T-shirts are 50% off regular price of $5.00 each.



1. The amount of the discount is

a) more than $2.00
b) less than $2.00
c) exactly $2.00

Show your reasoning with a number line or drawing.

2. A discount of $1.00 off a loaf of bread that costs $3.49 is

a) more than 25% of the regular price of the bread
b) less than 25% of the regular price of the bread
c) exactly 25% of the regular price of the bread

Show your reasoning with a number line or drawing.

3. Fill in the missing amounts in the gray boxes.

$5.00			
100%			
50%		50%	
$		$	
25%	25%	25%	25%
$	$	$	$

Shopping L4: Benchmark Fractions, Decimals and Percents
Handout - Fraction Strip Word Problems

1. You just made a recipe of lemon cookies. The recipe called for 3/4 cup of sugar. You decide you want them to be a bit sweeter next time you make them so you make a note to add an *extra* 1/8 of a cup of sugar next time. How much total sugar will you need for next time?

2. Derek has 5/8 of a cup of water and pours out 1/4 of a cup. How much does he have left?

3. Your son has a school project. He needs to create a diagram of blocks using 3 blocks – 1/2 “, 3/8” and 1/4” wide. What is the total width of these blocks if they are laid side by side?

4. There is a whole cake left after a party. You give 1/4 to your brother and 3/8 to your sister. How much is left? How much did you give away?

Lesson 5
Topic: Proportional Reasoning

Rationale

Consumer literacy is a topic that we commonly teach in our ESOL classes. Our students need to know how to read labels and advertisements, engage in purchasing transactions, and navigate systems regarding buying and selling products in the United States. All consumers want the best value for the lowest price, but sometimes figuring out the better deal is not obvious. What do we need to know as consumers, and how can we teach these skills to our learners?

Background

A ratio represents the relationship between two numbers. For example, **2** donuts for $**1.00** is a ratio. In math notation, a ratio can be written several ways: 2:1, 2/1, or even 2 to 1. Note that order matters! The order of the numbers corresponds to the ratio we are describing.

When two ratios are equal, they are *proportional***.** The opportunity for students to use proportional reasoning will be much greater when it builds on their intuitive understanding of familiar contexts, such as how quantity and cost are usually related when shopping. For this reason, we advocate keeping numbers in context as much as possible, especially at first.

Contextualize language and math at the level of your students. Numbers that divide evenly and whole numbers are generally easier to work with. Talk about food items your students typically purchase and use ads from the stores where they tend to shop. Later, students can use the concepts they have gained to make sense of more abstract numbers.

Topic: Proportional Reasoning	
Prior Knowledge	• Students are able to recognize most U.S. currency (coins and bills) and state the amount each represents. Example: *A nickel is worth five cents.* • Students are able to add and subtract two-digit numbers. • Students understand U.S. math notation (see Lesson 1: U.S. Currency). • Students have a conceptual understanding of fractions as equal parts. • Students are familiar with the notation of fractions.
ESOL Task	• Compare prices • Determine best buy • Predict an amount needed
Math Concepts Addressed	• Ratios and proportional relationships • Notation of ratios and proportions
Materials Needed	• Store advertisements with ratios • Paper • Colored pencils • Small whiteboards (1 per student), or paper • Teacher Resource: *Double the Donuts* • Teacher Resource: *2 for $3.00* • Handout: *Brownie Recipe*
Vocabulary list of math terms	*ratios* *proportions* *colon* *fraction* *equal*
Introduction / Warm Up	Using the teacher resource *Double the Donuts*, say to students: *I want to double the amount of donuts. Complete the picture to show me how much I will pay for double the amount.*
Activities	**I. Using visuals to show proportional relationships** 1. Use the teacher resource *2 for $3* advertisement provided, or create your own. 2. Elicit how they would describe the sale*: Two for three dollars.* 3. As they speak, write the numbers as a ratio: 2:3. Elicit how they might describe the relationship between the two numbers. Then write "ratio" on the board. When writing with a colon, be explicit the punctuation and be explicit that the colon, in this context, represents the relationship between the two numbers and we call that a ratio.

Recall that they know a colon from its use in telling time. Elicit uses of the colon in their culture. A colon is used for division in some countries.

4. Using white boards or paper, ask students if they know other ways to write a ratio without a colon. It can be written as a fraction. $\frac{2}{3}$.
5. Ask students to draw the ratio as they saw in the warm up activity. Then show an equal ratio by drawing it. Ask them to write the proportion in math terms: Ex: $\frac{2}{3} = \frac{4}{6}$ or 2:3 = 4:6.
6. Give students store ads with ratios and for each ad, they should:
   - Write the ratio in numbers.
   - Draw the ratio.
   - Draw an equal ratio.
   - Write the two ratios as a proportion.
7. Do a language lesson for talking about ratios with words such as: ***per***, ***for***, ***a*** and ask students to write sentences. For example: *The store has 2 avocadoes **for** 3 dollars*. As you move through the other activities in this lesson, have students write out sentences as we would normally describe the ratio: *2 for **a** dollar*; *$1.00 **per** mango*, *a dollar **a** mango*, etc.

Extending the activity
Use the *Brownie Recipe* handout provided or create your own and ask students to double or triple the recipe, keeping all the ingredients in proportion.

II. Using ratios for currency conversion
Note: You may want to research the rate of exchange for the currencies of your students' native countries.

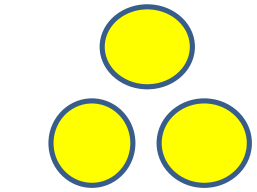
1. Ask students to write down the name of the currency in their native country.
2. If they don't know the rate of exchange, research it on the Internet and write it as a ratio. For example, the ratio between U.S. dollar to Chinese yuan is $1.00 USD : 6.65 Chinese CNŸ.
3. Create a table, commonly referred to as an In/Out Table. Students will build a currency conversion chart such as shown below. Start by doubling the numbers and then build out the table for the U.S. currency amounts: $5, $10, $20, $100.

US Dollars	Yuan
1	6.65
2	13.30
4	26.60
5	

	III. Using a table to make predictions Using an In/Out Table, students will fill in numbers to make a prediction. 1. Give students the case scenario: *You are having a party for 30 people. You are buying avocadoes for a salad. You normally use 2 avocadoes to make a salad for 4 people. How many avocadoes do you think you'll need?* 2. Create an In/Out Table, and build the first few proportions together and then allow students to complete the table. **Strategies for Differentiation** **More accessible**: • Use ratios that divide evenly such as: 1:2 or 5:10 • Simplify the party scenario in Activity III by using a smaller number of people and numbers that divide evenly such as a party for 10 people and avocadoes feed 5 people. **More challenging:** • Ask students to create their own scenario involving proportional relationships such as **miles : gallon** or **price : pound**
Assessments	Students create their own food shopping advertisements with ratios. They can draw the products or use store flyers. For each ad, they will: • Write in words the product and sale ratio. For example: There are 2 boxes of cereal for $5.00. • Draw the ratio as a picture representation: $\underline{00}$ $\$\$\$\$\$$ • Write the ratio using math notation: 2:5 • Double or triple the ratio. • Create a drawing to show the two ratios are equal. • Write the equivalent ratios as a proportion: $\frac{2}{5} = \frac{6}{15}$ **Technology Integration (optional): Teaching digital citizenship** Students can create their flyers using Microsoft Word, Google Docs or a free web-based application like www.smore.com. However, students should be aware of copyright laws and creative commons licenses. This is an opportunity to teach students how to search for images with proper usage rights. Here is a resource that explains how to filter images by usage rights: https://support.google.com/websearch/answer/29508?hl=en
Additional Resources	• *EMPower: Keeping Things in Proportion: Reasoning with Ratios* (teacher and student books). (2011). BW Walch. • *Proportional Reasoning* (ratios and proportions activities): http://tasks.illustrativemathematics.org/content-standards/6/RP

Donuts

3 for $4.00



$ $ $ $

=

2 loaves of bread for $3.00

Shopping L5: Proportional Reasoning
Handout - Brownie Recipe

Ginger wants to bake brownies. Her recipe calls for eight eggs. She has two eggs. She decides to bake a smaller amount and reduces the recipe.

a. What fraction of the recipe is she making? How do you know?

b. Show the amounts in her recipe change:

Super Gooey Brownies	Brownies with Only 2 Eggs
1 c. (cup) butter	
8 eggs	2 eggs
3 c. sugar	
2 c. flour	
2 tsp. vanilla	
6 oz. unsweetened chocolate	

c. Which ingredients were easy to adjust? Why?

d. Which ingredients were hard to adjust? Show how you solved these problems.

Lesson 6
Topic: Measurement

Rationale

The United States standard or customary system of measurement (also called the English, Imperial or American) is the most commonly used system of measurement in the United States. Although most ESOL students are better acquainted with the metric system of measurement, many items for sale in the U.S. (especially food) fortunately have both the English and metric equivalents listed on the packaging. This provides a base to build understanding of the relationship between the two measurement systems.

Background

According to the National Council of Teachers of Mathematics (2015), "Students need to develop an understanding of customary units and their relationships… Because some non-metric units of measure are common in particular contexts, students need to develop familiarity with multiple systems of measure, including metric and customary systems and their relationships." Because most ESOL teachers may be more comfortable with the customary system of measurement, it is important for teachers to familiarize and understand the metric prefixes which are combined with increments of length (meter), volume (liter) and weight (gram).

Each metric prefix increases or decreases by a factor of ten (see the table below).

kilo	hecto	deca	Base units: meter liter gram	deci	centi	milli

For example, it takes 10 milligrams to make 1 centigram and 1 deciliter is 1/10 of a liter. The chart can be a useful reference as well as realizing our monetary system is based on factors of 10 as well (10 dimes to make 1 dollar, 100 cents to make 1 dollar). Refer back to Lesson 2: Place Value for a discussion of factors of ten.

Topic: Measurement	
Prior Knowledge	• Students are able to recognize most U.S. currency (coins and bills) and state the amount each represents. Example: *A nickel is worth five cents.* • Students are able to add and subtract two-digit numbers. • Students understand U.S. math notation (see Lesson 1: U.S. Currency). • Students have a conceptual understanding of fractions as equal parts. • Students are familiar with the notation of fractions.
ESOL Task	• Read and interpret food labels • Estimate weight of serving size • Convert metric measurements to Imperial measurements
Math Concepts Addressed	• Ratios and proportional reasoning • Measure in standard units
Materials Needed	• Measuring cups and spoons • Food scale • Rulers and yardsticks • Containers filled with a product (box, jar, bag, can, bottle, package, bar of chocolate) • Set of *Handout: Vocabulary Cards – Containers* (1 per group of 4) • Teacher Resource: *Metric Word Web* • Teacher Resource: *Food Labels and Serving Size Activity* from http://sph.unc.edu/files/2014/07/Food-Labels-and-Serving-Sizes.pdf
Vocabulary list of math terms	*gram* *milligram* *kilogram* *liter* *ounce* *cup* *pint* *quart* *gallon* *pound*
Introduction / Warm Up	Place the various containers around the room. Group students and give each group a set of *Vocabulary Cards – Containers* to match with each object.
Activities	**I. Metric system** 1. Create a word web with "metric system" in the center (see sample Teacher Resource: *Metric Word Web*) and elicit metric measurements.

2. Using the example provided, students work together to build out the metric system.
3. Elicit the pattern they see (based on tenths).

(See Additional Resources section for useful websites on metric system information and practice).

Technology Integration (optional): Blended learning

Create a blended lesson by sharing online resources with students and give them an opportunity to first practice in class so they will know how to access them outside of class. Check to see if they are accessible on mobile devices.

Tip: Create a document or website that you can store digital resources for easy access. Hyperlink them so students do not have to remember long URLs. You can shorten the URLs using the free services at https://bitly.com/, https://goo.gl/, or https://tinyurl.com/.

II. Estimating measurements with sensory perception

1. Students close their eyes. Give each student an item to hold such as a chocolate bar, a package of cookies, a box of rice, etc. and ask them to estimate the weight in metric measurement. Students will make statements such as: *A chocolate bar weighs about 100 grams.* Record their estimates.
2. Ask students to open their eyes and read the labels to check the accuracy of their estimates.
3. Ask students if they can estimate the weight in the Imperial system by **feeling** the weight of the object in their hands. Students write sentences with their estimates.
4. Using measuring cups and spoons and food scale, students complete the table with equivalent Imperial measurements.
5. Place portions of food items such as cereal, rice, dried beans, bread, etc. in bowls and plates.
6. Ask students to estimate the weight by **visually** inspecting the objects, then write sentences. For example: *There is 1 cup or 8 ounces of cereal.*
7. In groups, have students use the measuring tools to check the accuracy of their estimates. They can put the cereal in the measuring cups, the bread on the food scale, etc.
8. Students write down the correct measurements next to the estimates.

III. Build conversion tables

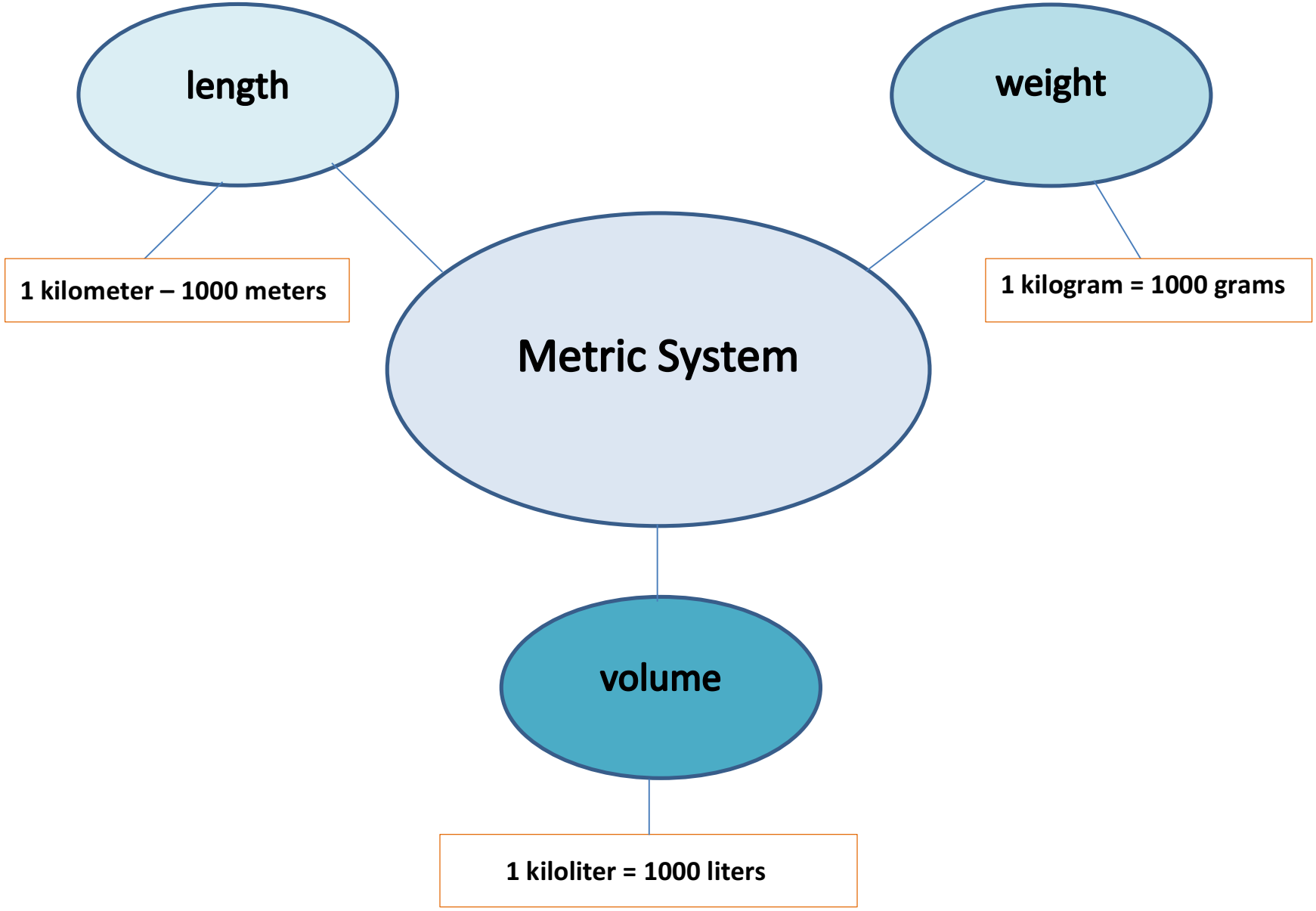
Build Conversion Tables for metric: imperial conversion using standard measurements such as: kilogram: pound; deciliter: ounces. You may want to limit conversions to principal units of measurement. See Lesson 5 on Proportional Reasoning.

	IV. Reading food labels Follow the instructions for the *Food Labels and Serving Size Activity* available from: http://sph.unc.edu/files/2014/07/Food-Labels-and-Serving-Sizes.pdf **Strategies for Differentiation** **More accessible**: • Limit measurements to the most common units: cup, ounce, tablespoon. **More challenging:** • Give students food labels to compare for nutritional values: sugar, carbohydrates, protein, fat, etc. See Additional Resources: *Food Label Activities.*
Assessment	1. Give students a food label. Using the serving size and measuring tools, students measure out the quantity of one serving. 2. Using food products and measuring tools, students measure out one cup, one tablespoon, one pint and one quart. Arrange them in order from smallest to largest.
Additional Resources	• *The Metric System* https://www.cuemath.com/measurement/metric-system/ • *Food Label Tool* (interactive quiz) http://www.nourishinteractive.com/nutrition-tools-healthy-family/parents-food-labels-nutrition-facts-tool • *Food Label Activities* https://cns.ucdavis.edu/sites/g/files/dgvnsk416/files/inline-files/ntgo2013lesson5.pdf • *EMPower: Over Around and Within* (teacher and student books). (2011). BW Walch.

Shopping L6: Measurement
Handout - Vocabulary Cards - Containers

box	**jar**	**bottle**	**box**	**jar**	**bottle**
bag	**package**	**can**	**bag**	**package**	**can**

Shopping L6: Measurement
Teacher Resource - Metric Word Web



Lesson 7
Topic: Data

Rationale

ESOL students are confronted with data displayed in many forms daily. They need to be able to interpret and analyze data using a variety of strategies. Students need to understand that data can be made to tell different stories, depending on the way they are categorized and displayed.

Background

The four types of graphs commonly used are bar, circle, line, and frequency graphs. Although they are sometimes used interchangeably, at times one graph is more useful than another. There is often more than one correct way to display a set of data. However, each type of graph has particular strengths and sometimes one type of graph is useless for a particular purpose. For example, a bar graph might be used to compare prices of items from various stores or a frequency graph might be utilized to present shopping trends.

Topic: Data	
Prior Knowledge	• Students are able to recognize most U.S. currency (coins and bills) and state the amount each represents. Example: *A nickel is worth five cents.* • Students are able to add and subtract two-digit numbers. • Students understand U.S. math notation (see Lesson 1: U.S. Currency). • Students have a conceptual understanding of fractions as equal parts. • Students are familiar with the notation of fractions.
ESOL Task	• Create a survey
Math Concepts Addressed	• Represent and interpret data
Materials Needed	• Handout: *Ice Cream Flavors* • Handout: *Survey Template* • Paper plates (in one or more colors depending on how you run the activity) • Sticky notes (large) • Teacher Resource: *Constructing a Circle Graph from a Bar Graph*
Vocabulary list of math terms	*graph* *whole* *circle* *pie chart / circle graph* *survey*
Introduction / Warm Up	1. Use the graph provided in the Ice Cream Flavors handout or create your own, and ask students to talk about what information they understand from the graph. 2. Talk about the circle as the whole, or 100%. Elicit responses to the following questions: *What must be the total percentage of the 2 parts/slices of the pie chart?* *How many categories do you see?*
Activities	**I. Class survey** Students will create a survey by asking classmates and/or family members and friends. 1. Using the *Survey Template* handout, students will think of a question with two categories. This should be a yes or no question or any question that limits the response to one of two options. For example:

Do you prefer chocolate or vanilla ice cream?

2. Students ask classmates or family and friends the question and record the responses. They can survey any number of people.
3. Give each student a white paper plate and using benchmark numbers, students estimate the percentage and color in the plate to represent their data. For example: If 4 of out 10 students prefer chocolate ice cream, the color representing chocolate should cover almost 1/2 of the plate. [An alternative to this is to give each student two different-colored pie plates that can be put together to make a pie chart that can be shifted around, creating various sized slices, or percentages. **See Lesson 4 Activity I: Extending the Activity for instructions and an illustration.**]

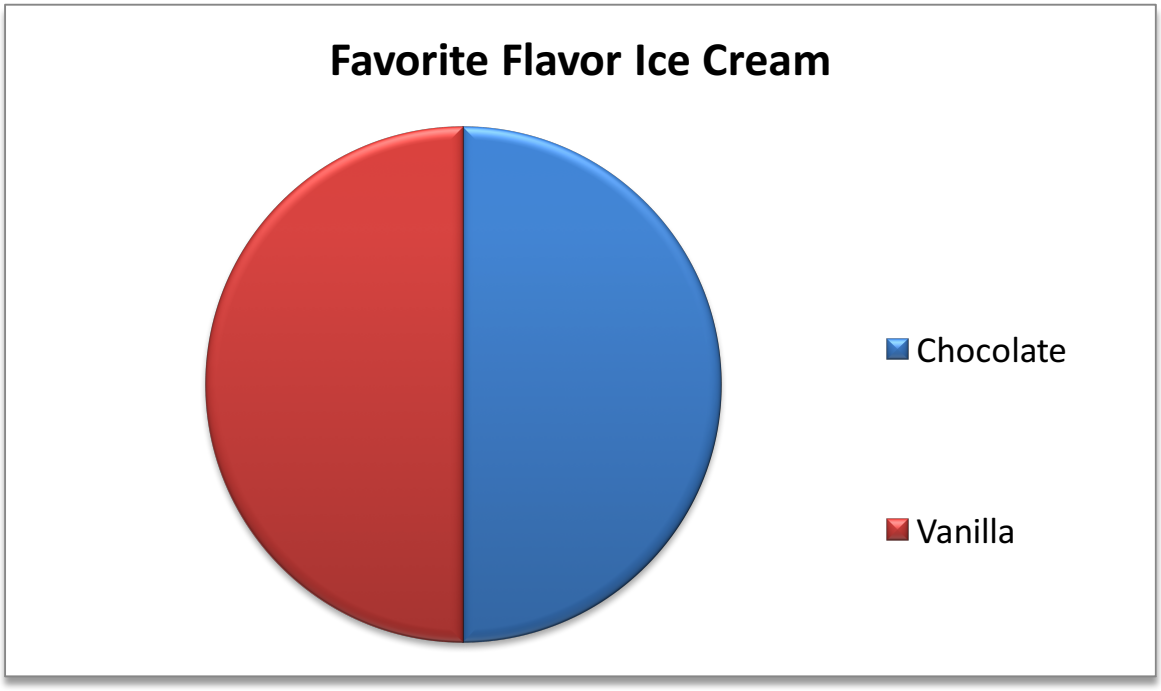
Extending the activity:
Note: before beginning this activity, review the teacher resource *Constructing a Circle Graph from a Bar Graph* in preparation for Steps 5-7.

Favorite Colors Activity

1. Ask students to jot down their favorite color on a large sticky note and post it to a common wall area for all to see.
2. Ask for a couple of volunteers to come up and categorize the data.
3. Then model the creation of first a frequency graph (with an "x" for each item in each category so students can clearly count each item) and then a bar graph (which covers up all the individual "x" marks which requires students to now use the y-axis to determine how tall each bar is). Post this on chart paper for all to see.
4. Now ask for a couple of other volunteers to collapse some of the categories (this will work well if there are lots of colors in the data set.) For example, if the colors chosen included orange, red, yellow, blue, green, students could be asked to create fewer grouping – which they could choose themselves. They could choose to reorganize the colors into warm and cool colors, or colors they like vs. don't like, or even primary colors vs. secondary colors.
5. Once the categories have been collapsed, create another bar graph and ask students to do likewise using different colors for each bar. Be sure to ask students to consider the two different bar graphs based on the same data so that they can see what happens when data gets collapsed into fewer categories. (This is an important big idea in understanding what happens when data are represented in graph form.)
6. Then cut out each bar of your graph and combine them for a pie chart as students do the same with their own graphs.
7. Debrief by asking about any aha moments that they had as they did the activity.

	Technology Integration (optional): Data to graphs If you are comfortable with Microsoft Excel or Google sheets, you could show more advanced students how to enter class data into a spreadsheet and then how to convert the data into a pie chart or bar graph. Learners can practice by creating their own survey with family members, entering the data on a spreadsheet and converting it to a graph. Students can create a presentation for the class using the visuals they have created. Another option is for students to practice using Google Forms to create an online version of their survey to collect data.
Assessments	**Option A:** Give students a graph and ask them to write sentences about the data. **Option B:** Give students a set of data. Ask them to create a bar and a circle graph, and then reorganize the data to illustrate how organizing data can change the story.
Additional Resources	• *Statistics for Action: Drawing Your Own Conclusions* https://sfa.terc.edu/materials/pdfs/drawing_your_own_conclusions.pdf • *Statistics for Action: Memorable Graphs* https://sfa.terc.edu/materials/pdfs/memorable_graphs.pdf • *EMPower: Many Points Make a Point: Data and Graphs* (teacher and student books). (2011). BW Walch.

Shopping L7: Data
Handout - Ice Cream Flavors



Shopping L7: Data
Handout - Survey Template

What do you prefer: _____ or _____?

Put an X for each person under the option they choose.

Option 1 _____	**Option 2 _____**

Shopping L7: Data
Teacher Resource - Constructing a Circle Graph from a Bar Graph

Demonstrate how a bar graph can be changed into a circle graph. Talk through this process as you do it. Draw students into decision-making where appropriate.

1. Start with a bar graph drawn on graph or chart paper, where each bar is a different color.
2. Cut out the bars.
3. Tape the bars together, end-to-end, creating one long strip.
4. Create a circle from the strip by connecting the two ends.
5. Trace the circle onto a new piece of paper.
6. Mark off where each category begins and ends.
7. Draw a line from the center of the circle to the marks on the edge of the circle, creating pie slices for each different section.
8. To keep track of the data, establish a legend or key, using one color for each bar. Record the legend next to the circle.
9. Write a title for your circle graph.