

Lesson 1.1: Introduction to Quantitative Reasoning

Theme: Citizenship

Introduction

Since this is your first assignment, the authors will be explaining how your daily assignments will be structured. An assignment is referred to as an *Out-of-Class Experience* (OCE). Each OCE has the same four sections:

- Making Connections to the Lesson
- Developing Skills and Understanding
- Making Connections Across the Course
- Preparing for the Next Lesson and/or Assessment

Making Connections to the Lesson

The purpose of this section is to help make sure you understand the most important ideas of the lesson. Sometimes it is hard to know what to focus on when you are in class. The authors have designed this curriculum to help you identify and remember important ideas through the following steps:

- Every lesson ends with a discussion. During this discussion, the class identifies the important mathematical ideas of the lesson.
- The Student Handout always ends with a section called Making Connections. In this section, you write down the important mathematical ideas.
- This section of your OCE always starts with a question that asks you to identify a main mathematical idea of the lesson. You are given four statements to choose from.
- In future OCEs, you will describe how mathematical ideas connect across lessons.

A *main mathematical idea* means that the idea is an important concept that helps explain how to do many different types of problems and helps connect different problems together. It may take you a while to be able to identify the main mathematical ideas of lessons. Your instructor will help you at first by making sure these ideas are discussed at the end of the lesson.

- (1) Which of the following statements correctly illustrates one of the *main mathematical ideas* of the lesson?
- (i) Asking good questions about quantitative information is important in quantitative reasoning.
 - (ii) Doubling means to multiply by 2.
 - (iii) Gun violence is a problem in the United States.
 - (iv) You should not use estimation.

Since this is your first time with this type of question, the authors are going to explain the answer to Question 1. The answer is (i) because asking questions about quantitative information is important in many different problem situations. The other answers may or may not be true, but they are not *main mathematical ideas* for this lesson. Specifically,

- (ii) is true, but it only applies to one type of procedure: doubling.
- (iii) is an opinion. You cannot say if it is true or false, and it is not a *mathematical idea*.

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- (iv) is not true. As you saw in the lesson, estimation is a valuable skill.

Developing Skills and Understanding

The purpose of this section of the OCE is for you to practice with the skills and concepts from the lesson. You will see questions directly related to the lesson. You will also see questions that apply the skills and concepts to different situations. The section will sometimes have reading material that helps explain the topics from the lesson. Later in the course, you can look back at this information as you review what you have learned.

Questions 2 and 3 highlight important quantitative reasoning skills that you will learn in this course.

Quantitative Reasoning Skill: Reading and interpreting quantitative information

The lesson from class focused on a statement about children “gunned down” in America. How was such an inaccurate statement published? It was based on another statement published earlier.¹ Both statements are shown below. Read them carefully and decide what each means mathematically.

Original Statement: The number of American children killed each year by guns has doubled since 1950.

Reworded Statement (circa 1995): Every year since 1950, the number of American children gunned down has doubled.

- (2) Based on the original statement and the reworded statement, which of the following comments is valid?
- (i) Both the original and reworded statements are interpreted to mean that the number of children gunned down has doubled *every year* between 1950 and 1995.
 - (ii) The interpretation of the reworded statement implies that the number of children gunned down has doubled *once* between 1950 and 1995.
 - (iii) Assume that the original statement is true. If approximately 100 children were killed by guns in 1950, the number of children killed by guns in 1995 was about 200.
 - (iv) The phrase “children killed” has the same meaning as “children gunned down.”

This highlights the importance of reading and writing carefully about quantitative information. The original and reworded statements look very similar, but mean entirely different things:

- The original statement says that the number has doubled *once* from 1950 to the published date (1995).

¹Best, J. (2001). *Damned lies and statistics*. University of California Press: Berkeley and Los Angeles.

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- The reworded statement says that the number has doubled *every year* between 1950 and the published date (1995).

Quantitative Reasoning Skill: Identifying information that can be verified (checked to see if it is true)

- (3) Which of the following statements contain quantitative information? There may be more than one correct answer.
- (i) Many Americans have diabetes.
 - (ii) ABC News reported that the number of Americans that have diabetes could triple in the next 40 years.²
 - (iii) About a fourth of Americans with diabetes are over 65 years old according to the American Diabetes Association.³
 - (iv) Diabetes is a terrible disease.

One characteristic of quantitative information is that it contains numerical information. Another is that it has information that can be checked or evaluated. The statement “Many Americans have diabetes” sounds quantitative. *Many* implies a number, but it is also a judgment. How much is *many*? There is no way to verify this statement because you could have different opinions about the meaning of “many.” “Diabetes is a terrible disease” is also a judgment. You can offer quantitative information to support the statement, but you cannot verify that this is true or false. Being able to evaluate a claim based on quantitative information is an important quantitative reasoning skill.

Quantitative Reasoning Skill: Naming and estimating large numbers

Large numbers often occur in real-life situations, but it is hard to make sense of them. It is difficult to imagine the distinction between a million and a billion. You will do more work with understanding the size of these numbers in Lesson 1.2, but first you will work on recognizing the numbers and names. If you need some review on place value, you can view the following videos:

- www.khanacademy.org/video/place-value-1?playlist=Developmental%20Math
- www.khanacademy.org/video/place-value-2?playlist=Developmental%20Math
- www.khanacademy.org/video/place-value-3?playlist=Developmental%20Math

²Retrieved from <http://abcnews.go.com/WN/diabetes-rise-america-slow-growth-world-news-question/story?id=11945648>.

³Retrieved from www.diabetes.org/diabetes-basics/diabetes-statistics.

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(4) The following place-value chart is partially labeled.

Place-Value Chart

Hundred trillions				Ten billions		Hundred millions	Ten millions			Ten thousands	Thousands	Hundreds	Tens	Ones	
												10^2	10^1	10^0	Power of 10

- (a) Fill in the missing name labels on the Place-Value Chart.
- (b) Fill in the power of 10 that corresponds to each position on the Place-Value Chart. (Entries for 10^0 in the ones place, 10^1 in the tens place, and 10^2 in the hundreds place have already been entered.)
- (5) Which of the following represents the number: “Six billion, nine hundred ten million, one hundred fifty-two thousand, eight hundred twenty-four”?
- (i) 6,910,152,824
 - (ii) 600,910,152,824
 - (iii) 6,000,910,152,824
 - (iv) 6,910,001,052,824

In Question 4 of the lesson, you practiced estimating and naming large numbers. Large numbers are also estimated in another way that combines numbers and words. Look at the examples below.

35,432,000 rounded to 35.4 million

Think of 35.4 million as a multiplication problem of 35.4 times 1 million:

$$35.4 \times 1,000,000 = 35,400,000$$

This gives the same result as estimating 35,432,000 in millions.

Here is another example:

1,452,900,812 rounded to 1.5 billion

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(6) Select the number/word combination that best estimates each number.

(a) 87,300,000

(i) 8.7 million

(ii) 87.3 billion

(iii) 87.3 million

(b) 2,670,000,000,000

(i) 2.7 trillion

(ii) 2.7 billion

(iii) 2700 million

(c) 234,700,000,000

(i) 235 trillion

(ii) 235 billion

(iii) 235 million

(7) Following are some data about diabetes in the United States from the American Diabetes Association.⁴ Complete the table either by writing the words as a number or as a combination of words and numbers.

	Number	Word/Number Combination
Number of children and adults with diabetes in 2010		25.8 million
Number of children under age 20 with diabetes in 2010	215,000	
Cost due to diagnosed diabetes cases in 2007—includes medical costs, disability payments, loss of work, and premature death	\$174,000,000,000	

⁴Retrieved from www.diabetes.org/diabetes-basics/diabetes-statistics.

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Quantitative Reasoning Skill: Rounding numbers

Another important skill you used in this lesson is rounding. You often round numbers when you are trying to make sense out of them or make comparisons and do not need exact numbers. In this lesson, you found that the statement predicted that trillions of children were gunned down in 1995. This was enough to know that the statement was not reasonable because that was more than the entire population of the United States (and in fact, the world). You did not need to have exact numbers.

If you need review on rounding, you can view the following videos:

- www.khanacademy.org/video/rounding-whole-numbers-1?playlist=Developmental%20Math
- www.khanacademy.org/video/rounding-whole-numbers-2?playlist=Developmental%20Math
- www.khanacademy.org/video/rounding-whole-numbers-3?playlist=Developmental%20Math

- (8) The following website has two population clocks that update every minute to show the estimated populations of the United States and the world (www.census.gov/main/www/popclock.html). At 7:29 p.m. (central standard time) on April 5, 2011, the clocks showed the following values.

	Estimated Population Count from Website	Rounded Number (round to the place value indicated)	Name of Rounded Number
U.S. population	311,105,182	311,000,000 (round to nearest million)	311 million
World population	6,910,152,824	7,000,000,000 (round to nearest billion)	7 billion

- (a) Go to the population clock website. Record the current population estimates and the time at which you recorded them. Complete the table as indicated.

Time recorded: _____

	Estimated Population Count from Website	Rounded Number (round to the place value indicated)	Name of Rounded Number
U.S. population		(round to nearest million)	
World population		(round to nearest billion)	

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- (b) Wait at least 10 minutes and go back to the population clock (either close and reopen the website or refresh the website). Record the new values.

Time recorded: _____

	Estimated Population Count from Website	Rounded Number (round to the place value indicated)	Name of Rounded Number
U.S. population		(round to nearest million)	
World population		(round to nearest billion)	

- (c) Did the estimated population counts change?
- (d) Did the rounded numbers change?
- (e) If you were making a calculation based on population, would you use the population count or the rounded number? Be prepared to justify your answer.

Making Connections Across the Course

This section of the OCEs will help you make connections between concepts across the course. In Making Connections, you will be using concepts, skills, and situations from previous assignments and previewing topics you will use in later assignments.

There are five lessons in the first unit of the course: 1.1–1.5. These lessons will help you develop some very important skills you will use throughout the course. These include the following:

- Reading quantitative information.
- Writing statements using quantitative information.
- Understanding large numbers:
 - place value.
 - reading and writing large numbers in both words and digits.
 - the size of numbers.
 - comparing the relative size of numbers.
- Estimation.
- Understanding, estimating, and calculating percentages.
- Fundamentals of calculations:
 - order of operations.
 - different ways to write and perform calculations.

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By the end of this module, you should also understand some important points about this course:

- What quantitative reasoning is.
- Your responsibility for:
 - creating and contributing to the classroom learning environment.
 - being prepared for class.
 - completing your work.
 - planning and monitoring your own learning and course progress.
- How to be an effective member of a work group.
- Strategies for working on difficult problems.

The following questions will help you prepare for this course:

- (9) What are your goals for this class?
- (10) What academic and nonacademic strengths do you bring to the class? **Examples:** time to work in the tutoring center or to meet with classmates, good support at home so you can focus on your studies, confidence in yourself based on your past experiences either in school or in other aspects of your life.
- (11) Do you have any questions or concerns you want to ask your instructor?

Preparing for the Next Lesson (1.2)

Your instructor expects you to be prepared for the next class. This section tells you what you need to know and be able to do to be prepared. You will be asked to rate how confident you are that you can do certain things. Be honest when you rate yourself. You will not be graded on the rating. If you do not feel confident, get help on the topic before class. Talk to your instructor about ways you can get help on campus.

Reread the information from Lesson 1.1 that describes this course:

This course is called a *quantitative reasoning* course. This means that you will learn to use and understand quantitative information. It will probably be different from any other math class you have ever taken. You will learn and use mathematical skills, but they will be connected to situations like the one you discussed in this lesson. You will talk, read, and write about quantitative information. The lessons will focus on three themes:

- Issues of citizenship: understanding your society, government, and world (the situation from today's lesson is an example)
- Personal finance: understanding financial information and how to use it to make decisions
- Medical literacy: understanding the meaning of information about risk of disease and effectiveness of treatment

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The purpose of today's lesson was to introduce you to the idea of quantitative reasoning and give you a picture of what the class will be like. Do not worry if you did not understand all of the math concepts. You will have more time to work with these ideas throughout the course. Some other skills you will learn are

- how to understand and make sense of quantitative information.
 - how to evaluate quantitative information (like you did in this lesson when you were asked if the statement was reasonable).
 - how to use quantitative information to make decisions.
- (12) Give one example for each theme that would be of particular interest to you (possibly an experience or a question that you have encountered).
- (a) Issue of citizenship
 - (b) Issue of personal finance
 - (c) Issue of medical literacy

Self-Regulating Your Learning—An Introduction

One goal of this course is to increase your ability to learn efficiently and effectively. This means learning faster and learning smarter—what scientists call being a “self-regulated learner.” The following section explains what this means.

Self-regulating your learning means you **plan** your work, monitor your **work** and progress, and then **reflect** on your planning and strategies and what you could do to be more effective. These are the three phases of Self-Regulated Learning (SRL). They are introduced below, and will be followed up on later on in the course.

Plan: Before doing a problem or assignment, self-regulated learners **plan**. They think about what they already know or do not know, decide what strategies to use to finish the problem, and plan how much time it will take. Research has shown that math experts often spend much more time planning how they will do a problem than they do actually completing it. Novices, the people who are just starting out, often do the opposite.

Work: Self-regulated learners use effective strategies as they **work** to solve problems. They actively **monitor** what study strategies are working and make changes when they are not working. When they do not know which strategy would be better, they ask for help. Self-regulated learners also keep themselves focused while they are working and pay attention to their feelings to avoid getting frustrated.

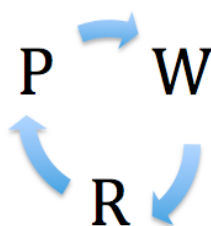
Reflect: Usually after an assignment or problem is done, self-regulated learners take time to reflect about what worked well and what did not. Based on that reflection, they think about how to change their approach in their future. The **reflect** phase helps self-regulated learners understand more about how they learn so they can become more efficient and more effective

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the next time. Reflecting is important for doing a better job next time you plan for a new problem or assignment.

You can think of these three phases as a cycle. You incorporate what you learned during the reflect stage in your *next* plan phase, making you a more effective learner as you repeat this process many times. The most effective students get in the habit of working this way:



For most people, self-regulating takes time, practice, and hard work, but it is always possible. People can improve even if, in the beginning, they did not self-regulate their learning very well. The more you practice something and the more you train your brain to think in certain ways, the easier it becomes.

Since thinking this way takes practice, you will have opportunities to practice some of these skills as you progress through this course. As you read through the lessons and homework assignments, you will encounter activities that are designed to help you to incorporate the Plan, Work, and Reflect phases in specific ways. Take the time to thoughtfully complete these exercises. The payoff will be worth it!

Self-Regulated Learning—Plan

Part of effectively planning for what could be new material for you is figuring out how much you already know. In Lesson 1.2, you will need to be able to do the following things:

- Double values in contextual situations.
- Identify place value to the trillions.
- Read a table of numbers.
- Add and subtract numbers.

(13) To effectively plan and use your time wisely, it helps to think about what you know and do not know. For each of the following, rate how confident you are that you can successfully do each task. Use the following descriptions to rate yourself:

- 5—I am extremely confident I can do this task.
- 4—I am somewhat confident I can do this task.
- 3—I am not sure how confident I am.
- 2—I am not very confident I can do this task.
- 1—I am definitely not confident I can do this task.

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Before beginning Lesson 1.2, you should understand the concepts and demonstrate the skills listed below:

Skill or Concept: I can...	Rating from 1 to 5
Double values in contextual situations.	
Identify place value to the trillions.	
Read a table of numbers.	
Add and subtract numbers.	

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