

# Estimation Using Whole Numbers

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*In this article, the author presents three major reasons for making estimates to computational situations/problems. He then discusses, along with specific examples, four commonly used estimations strategies. Included, at the conclusion of the article, are exercises, problems, and activities for the students.*

## Introduction

According to the National Council of Teachers of Mathematics (NCTM) in its *Principles and Standards for School Mathematics* document, “Instructional programs from prekindergarten through grade 12 should enable all students to compute fluently and make reasonable estimates” (NCTM, 2000). This statement is also supported in the *Common Core State Standards* for grades 3–4 (Corestandards.org, 2010). In everyday situations, quick mental calculations, which do not necessarily need to be exact, must be made. For example, when shopping at a grocery store, estimating the total cost of selected items will avoid the embarrassment of returning items at checkout. In addition, with the continued and expanded use of calculators, an estimate of a computation is often necessary to determine if a computed answer is reasonable. In other words, the consistent use of technology for computational purposes demands that students be able to use estimation skills.

Remember that the “best” estimation strategy often depends upon the numbers and operations involved and the context of the problem that needs to be solved. In addition, there is no one correct estimate. An estimate is just that, an estimate. A given problem may have numerous legitimate estimates. The key is to have the students provide an estimate, along with an explanation of how they arrived at their particular estimate. In addition, the students should be able to explain if their estimate is a “high” estimate

or “low” estimate. Classroom time should be provided to help students develop their estimation skills. These skills can be very beneficial to students in applications outside the classroom.

There are numerous estimation techniques. This article focuses on the most common estimation strategies for the whole number operations, provides reasons for making estimates, and presents classroom-tested exercises, problems and activities.

## Reasons to Estimate

*To check if a computed answer is reasonable.* Using estimation skills can help students catch and, therefore, help reduce the number of errors made by pressing the wrong key on a calculator (for example, pressing the multiplication key instead of the addition key) or determine if the appropriate computation was used.

*If an exact answer is not possible, practical, or necessary.* It may not be possible for a company to determine the exact number of blank compact disks that people will purchase in the next year. It may not be necessary to determine the exact amount of money that you will need to go grocery shopping, as long as you have a sufficient amount of money to spend. It may not be practical to measure the exact height of a very tall tree.

*To help develop number sense.* Encouraging students to estimate their answers before computing will help them develop number sense by requiring them to focus on conceptual understanding and not just the

computational process. Making estimations requires a firm knowledge of place value, a major component of number sense.

## Strategies

### **Rounding**

This strategy involves rounding numbers to a specific place value and then computing with the rounded numbers.

$57 + 82 + 48$  is about  $60 + 80 + 50 = 190$ .  
 $78 \times 309$  is about  $80 \times 300 = 24000$ .

### **Front End**

This strategy focuses on the lead digits of the computation. The lead digits are assigned an appropriate place value, depending upon whether or not the estimate is to be a high estimate or a low estimate.

$33 + 74 + 58$  is about  $40 + 80 + 60 = 180$  (high estimate).  
 $33 + 74 + 58$  is about  $30 + 70 + 50 = 150$  (low estimate).

### **Clustering**

This strategy can be used when a group of numbers “clusters” around a common number. This strategy is limited to certain kinds of computations, most commonly with multiplication.

$52 + 47 + 54 + 49$  is about  $4 \times 50 = 200$ .

### **Compatible Numbers**

This strategy can be used when a set of numbers can be easily manipulated mentally.  
 $23176 \div 612$  is about  $24000 \div 600 = 40$ .

To determine a high estimate when dividing, estimate the dividend “up” and the divisor “down” (so that the computation is easy to do).

$23176 \div 612$  is about  $25000 \div 500 = 50$ .

To determine a low estimate when dividing, estimate the dividend “down” and the divisor “up” (so that the computation is easy to do).  
 $23176 \div 612$  is about  $21000 \div 700 = 30$ .

## Exercises

Estimate the answer, indicate if the estimate is a high or low estimate (and provide a justification), and provide a description

of your thinking as you solved the exercise. Be sure that you discuss the reason(s) for selecting the strategy that you used.

- $863 + 571 + 429$
- $93 \times 87$
- $23 + 21 + 19 + 24 + 18$
- $99 \times 57$
- $14,003 - 12,009$
- $73,457 \div 89$
- $627 - 243$
- $8,637 \div 2,423$
- $379,632 \times 2079$
- $21 \times 38$
- $87 + 83 + 92$

## Problems/Activities

- List three “real world” situations in which you have recently used estimation. Be specific.
- In each of the following situations, provide a reason why an estimate might be more appropriate than an exact answer:
  - You want to determine the amount of time it will take your family to drive from Baltimore, Maryland, to Columbus, Ohio.
  - You want to decide how much money to take to Disney World for one week.
  - You want to know how many people will attend an upcoming school function.
- Estimate the total number of cars that can park in a near-by shopping mall. Provide an explanation of how you arrived at your estimate.
- Create a shopping list of 15 items that your family regularly purchases at the local grocery store. Next to each item list its estimated price (to the nearest dollar). Estimate a total price for these items to determine the total estimated cost of these 15 items. Now go to your local grocery store and record the actual price for each of the 15 items. Add these actual prices together to determine the total

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cost of the 15 items. Be sure to include the appropriate sales tax, if applicable. Discuss the reason(s) for making such estimates either prior to or during your shopping trip.

5. (a) Refer to the data below. Estimate the number of calories that Tayler burns in one week if she uses the stair master for 2 hours per week and walks for 4 hours per week. Is your answer a high or low estimate? Justify your answer.  
 (b) Refer to the data below. If Tayler lifts weights 5 hours per week and rides her bicycle 3 hours per week, estimate the number of calories she burns in one month from doing these activities. Is your answer a high or low estimate? Justify your answer.

Activity	Calories Per Hour
Stair Master	375
Walking	312
Lifting Weights	390
Bike riding	275

6. Sam has \$100 to spend. He wants to buy five items: a video game for \$32, a music CD for \$15, a DVD for \$17, a book for \$23, and a magazine for \$8. Using your estimation skills, how much money should Sam take to be sure he has enough money to purchase all of these items? Justify your answer.
7. A local youth baseball team needs to sell \$3523 worth of raffle tickets to play in a regional tournament. If each ticket costs \$4, about how many tickets will the team have to sell to meet its goal? Justify your answer.
8. The Moyer Candy Factory makes 871 pieces of chocolate candy every day. About how many pieces of chocolate does it make in 76 days? Explain your reasoning.

9. Lauren needs to collect at least 100 baseball cards to earn her collectors merit badge. In the last three days, she received 31, 15, and 43 cards from her friends. Use your estimation skills to determine if she needs to obtain more cards to earn her merit badge. Explain your reasoning.

### Works Cited

Corestandards.org (2010) *Common Core State Standards for Mathematics*. Available at <http://www.corestandards.org>.  
 National Council of Teachers of Mathematics (NCTM) (2000) *Principles and Standards for School Mathematics*. Reston, VA: Author.



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### Activate me!

“The spread of activity from an activated node [neural circuit] to its partners is of fundamental importance because it influences almost all aspects of human thought, cognition, and behavior.”  
 Buonomano, D. (2011). *Brain bugs: How the brain’s flaws shape our lives*, 35. W. W. Norton & Company, NY.