

### Activity 3: Words, Pictures, and Equations

In the following, you'll be asked to solve problems that require you to represent real-world quantities (distance, weight, money, etc.) with letters. These letters (variables) can be thought to stand for the *actual* (although not necessarily known) value of the quantity, along with the proper units. We'll choose the letters representing each quantity in this activity, but in a general setting it is possible to use whatever letters are most convenient for yourself and others.

1. a) Jasmin's grandparents offer to pay her 5 cents for every apple she picks from their orchard, but after counting her apples will withhold 2 cents for every bad apple they find. Write an equation representing how much money she will make from picking a certain number of apples, some of which are bad.  
(Variables:  $M$  = amount of money,  $A$  = number of apples, and  $B$  = number of bad apples)

b) Using algebra, you can often rewrite equations in a form that gives you a new perspective on your problem. Another form for the equation you wrote in part a is  $M = m_1(A - B) + m_2B$ , where the units of  $m_1$  and  $m_2$  are cents per apple. Find what  $m_1$  and  $m_2$  have to be such that this new equation is the same as the equation you wrote in part a, and describe what the quantity  $A - B$  represents. Finally, give a commonsense (verbal) interpretation of what this equation says.

c) Instead of counting the apples individually, Jasmin's grandfather sorts the good and bad apples into different bins, and then weighs each bin. He then uses these weights to figure out her pay, under the assumption that  $w$ , the average weight of each apple, is half a pound. Rewrite your equation from part b so that it is a function of the quantities  $b = \frac{B}{w}$  and  $g = \frac{A - B}{w}$ , rather than  $B$  and  $A - B$ . With this new equation, either Jasmin

or her grandfather can calculate her payment ( $M$ ) directly as a function of the bin weights, without having to count apples.  
(Variables:  $g$  = weight of “good” bin in pounds,  $b$  = weight of “bad” bin in pounds)

d) After collecting her money, Jasmin learns that her grandparents' apples more accurately weigh  $\frac{2}{5}$  of a pound each. Figure out whether Jasmin should have gotten paid more or less, first using verbal reasoning, and then using the equation you derived in part c, with  $w = \frac{2}{5}$  lb per apple. These methods should agree.

2. a) In planning her busy day, Daniella finds that she needs to ride the subway from her apartment first due West 10 miles, then Northeast 7 miles, and finally Southeast 20 miles. By drawing a diagram on graphing paper and using a ruler, figure out about how far from home she is after concluding her last errand.

b) After getting on the subway, Daniella realizes that she forgot a book that needs to be returned at the library, which lies a mere block from her final stop. Based on her route, does it look like she'll be riding near her house at anytime later in the day, so that she can get off and quickly pick up her book? If so, circle this point on your diagram, and figure out about how far it is from her house.

c) When people think of math and physics, they often just think of a bunch of equations. However, you found your answer to part b through drawing diagrams, and without any equations at all! See if you can think of a way to answer part b instead using **only** equations, and without drawing a diagram. If you can't, try to explain why this approach is more difficult here than what you did in parts a and b. This is an example of a general phenomenon in math and physics, that certain problem solving techniques (equations, diagrams, graphs, verbal reasoning, etc.) are better suited for certain types of problems than others.

3. a) A movie theater offers a family matinee special: adult admission is \$6, and admission for children under 14 is \$2. What is the theater's revenue at this showing if A adults and C children come to see the movie?

b) The employee checking tickets counts 12 families, 8 couples, and 5 individuals enter the movie. If the average family entering consists of one adult and two (under-14) children, how much should the theater's revenue have been that night?

c) After all is said and done, the revenue for that showing ended at \$230. Does this agree with your answer from b? If not, assuming everything you were told in part b is true, can you think of any possible reasons for this discrepancy? In order to answer part b, did you need to make any additional assumptions, beyond what you were given?