Applications

It is never too early to encourage long-term savings.

—Ron Lewis, politician

1. How might the words in the quote apply to what has been outlined in this section? See margin.
2. Suppose that \$1,000 is deposited into an account that yields 0.85% interest, compounded annually. How much money will be in that account at the end of 4 years? \$1,034.44
3. Arianna deposits \$500 in an account that pays 1.3% interest, compounded semi-annually. How much is in the account at the end of 2 years? \$513.13
4. When Derrick turned age 15, his grandparents put \$10,000 into an account that yielded 1.4% interest, compounded quarterly. When Derrick turns 18, his grandparents will give him the money to use toward his college education. How much does Derrick receive from his grandparents on his 18th birthday? \$10,428.18
5. Barbara wants to restore her '66 Mustang in 4 years. She puts \$200 into an account every month that pays 1.05% interest, compounded monthly. How much will be in the account after 4 years? \$9,800.07
6. Robbie opens an account at a local bank by depositing \$100. The account pays 2.4% interest, compounded weekly. He deposits \$100 every week for 3 years.
   a. How much is in the account after 3 years? \$16,171.46
   b. Write the future value function if x represents the number of weeks. See margin.
   c. Use a graphing calculator to graph the future value function. See margin.
   d. Using the graph, what is the approximate balance after 2 years? \$10,600
7. Suppose \$600 is deposited into an account every quarter. The account earns 1.5% interest, compounded quarterly.
   a. What is the future value of the account after 5 years? \$12,437.27
   b. Write the future value function if x represents the number of quarters. See margin.
   c. Use a graphing calculator to graph the future value function. See margin.
   d. Using the graph, what is the approximate balance after 3 years? \$7,350.37
8. When Abram was born, his parents put \$2,000 into an account that yielded 1.2% interest, compounded semi-annually. When he turns age 16, his parents will give him the money to buy a car. How much will Abram receive on his 16th birthday? \$2,421.95

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Exercise 4

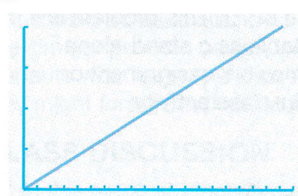
Alert students that the elapsed time of this account is not a number given in the problem statement but rather needs to be determined by using the time that elapsed from when Derrick turned 15 to his 18th birthday.

ANSWERS

1. Answers will vary but should include some mention of the fact that the longer an amount is in a savings account the more it will accrue in interest. Therefore, the earlier the start of the account, the better.

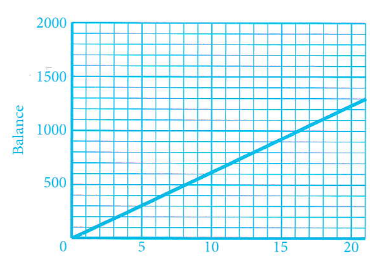
6b. $$B = \frac{100\left(\left(1+\frac{0.024}{52}\right)^x - 1\right)}{\frac{0.024}{52}}$$

6c.



7b. $$B = \frac{600\left(\left(1+\frac{0.015}{4}\right)^x - 1\right)}{\frac{0.015}{4}}$$

7c



9. Sydney invests $100 every month into an account that pays 0.8% annual interest, compounded monthly. Benny invests $80 every month into an account that pays 2.2% annual interest rate, compounded monthly.
   a. Determine the amount in Sydney's account after 10 years. $12,488.73
   b. Determine the amount in Benny's account after 10 years. $10,726.94
   c. Who had more money in the account after 10 years? Sydney
   d. Determine the amount in Sydney's account after 30 years. $40,672.12
   e. Determine the amount in Benny's account after 30 years. $40,739.94
   f. Who had more money in the account after 30 years? Benny
   g. Write the future value function for Sydney's account where x represents the number of months. See margin.
   h. Write the future value function for Benny's account where x represents the number of months. See margin.
   i. Graph Benny and Sydney's future value function on the same axes. See Additional Answers.
   j. Explain what the graph indicates. See margin.

10. You are constructing a future value spreadsheet. Users will be asked to enter the periodic investment in cell A3, the interest rate as an equivalent decimal in cell A4, the time in years in cell A5, and the number of times per year the interest is compounded in cell A6. Cell A8 will contain the future value of the periodic investment. Write the formula that will display this value in A8. See margin.

11. Albert Einstein said that compound interest was "the most powerful thing I have ever witnessed." Work through the following exercises to discover a pattern Einstein discovered, which is now known as the Rule of 72.
   a. Suppose that you invest $2,000 at a 1% annual interest rate. Use your calculator to input different values for t in the compound interest formula. What whole number value of t will yield an amount closest to twice the initial deposit? Approx. 70 years
   b. Suppose that you invest $4,000 at a 2% annual interest rate. Use your calculator to input different values for t in the compound interest formula. What whole number value of t will yield an amount closest to twice the initial deposit? Approx. 35 years
   c. Suppose that you invest $20,000 at a 6% annual interest rate. Use your calculator to input different values for t in the compound interest formula. What whole number value of t will yield an amount closest to twice the initial deposit? Approx. 12 years
   d. Albert Einstein noticed a very interesting pattern when an initial deposit doubles. In each of the three examples above, multiply the value of t that you found times the percentage amount. For example, in part a, multiply t by 1. What do you notice? You get a number close to 72
   e. Einstein called this the Rule of 72 because for any initial deposit and for any interest percentage, 72 ÷ (percentage) will give you the approximate number of years it will take for the initial deposit to double in value. Einstein also said, "If people really understood the Rule of 72 they would never put their money in banks." Suppose that a 10-year-old has $500 to invest. She puts it in her savings account that has a 1.75% annual interest rate. How old will she be when the money doubles? 51 years old

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Exercise 9

Ask students to predict who will have the most money in the account after 20 years and why. Then, after completing all the parts of the problem, ask if their predictions were backed by the math and graph.

9g. $B = \dfrac{100\left(\left(1+\dfrac{0.008}{12}\right)^x - 1\right)}{\dfrac{0.008}{12}}$

9h. $B = \dfrac{80\left(\left(1+\dfrac{0.022}{12}\right)^x - 1\right)}{\dfrac{0.022}{12}}$

9j. Sydney's balance starts out higher than Benny's. Close to the end of the 29th year (around 357 months), Benny's amount overtakes Sydney's.

10. =(A3*((1+A4/A6)^(A6*A5)–1))/(A4/A6)

Exercise 11

This is an excellent guided discovery exercise. Here, students discover Einstein's Rule of 72. This problem is suitable as a stand-alone homework assignment or an in-class activity.