Unit 6
Saving

Lesson 6B:
Simple and Compound Interest—Why It Is Great to Save

Rule 6: Pay yourself first.

Saving is making the decision to buy goods and services in the future rather than today. It can be difficult to save because people naturally prefer to enjoy things now and incur costs later. Banks offer interest as an incentive for people to save. These lessons look at why it is hard to save and why it pays to save (the opportunity to earn compound interest).

Lesson Description

Formulas for simple and compound interest, as well as the Rule of 72, are explained and used to illustrate the benefit of saving in general and the benefit of saving early in particular.

Standards and Benchmarks (see page 141)

Grade Level

9-12

Concepts

Annual interest rate

Compound interest

Principal

Rule of 72

Simple interest

Compelling Question

How can savers benefit from compound interest?

Objectives

Students will be able to

- calculate the change in the value of an asset with (i) simple interest or (ii) compound interest and
- estimate the change in the value of an asset using the Rule of 72.

Materials

- Visual 6B.1: Simple Interest
- Visual 6B.2: Compound Interest
- Visual 6B.3: The Rule of 72
- Visual 6B.4: Jack and Jill
- Handout 6B.1: Calculating Interest
- Handout 6B.2: Assessment
- A calculator for each student

Time Required

45 minutes

Procedure

1. Write "$100" on the board. Define **simple interest** as an annual payment based on a percentage of the amount you save. This percentage is called the **annual interest rate**. The original amount of money you deposit or invest, excluding any interest or dividends, is called the **principal**.

2. Discuss the following:
   - Suppose that you save $100 at an annual interest rate of 8 percent. (Add on to "$100" to have "$100 × 0.08 = $8.00" on the board).
   - 8 percent written in decimal terms is 0.08. (Instruct the students to move the decimal point in the percentage figure two places to the left.)
   - $8 is the interest earned in one year, so you would have $108.00 after one year.
   - $108 is the original $100 plus the interest. (Write the following on the board.):
     $100 × 0.08,
     or $100 + $100 (0.08),
     which can be written as $100 (1 + 0.08).

3. Display *Visual 6B.1: Simple Interest*. Explain that the visual shows a general formula for calculating interest as just discussed. Illustrate the use of the formula with the information from Step 2:

4. Distribute a copy of *Handout 6B.1: Calculating Interest* and a calculator to each student. Have the students practice using the simple interest formula with the saving scenarios on Part 1 of Handout 6B.1. They will need to calculate both the interest earned and the value of the savings after one year. Allow time for students to work and then review their answers.

Handout 6B.1: Calculating Interest: Part 1—Answer Key

Principal	Annual interest rate	# of Years	Interest earned	Value
$ 50	5%	1	*$ 2.50*	*$ 52.50*
$200	7%	1	*$14.00*	*$214.00*
$ 60	10%	1	*$ 6.00*	*$ 66.00*
$ 40	4%	1	*$ 1.60*	*$ 41.60*

5. Discuss the following:
   - What would happen if you left the $108 in savings for another year at the same interest rate—8 percent? (*They would make more interest.*)

6. Instruct the students to use the simple interest formula to determine how much their savings of $108 would be at the end of the second year. (*$108 × [1 + 0.08] = $116.64.*) Discuss the following:
   - How much interest would be earned the second year? (*$8.64*)
   - Why would the interest in the second year be more than in the first year? (*Because interest was earned not only on the original $100, but also on the previous interest of $8.*)

7. Define **compound interest** as interest that is earned not only on the principal but also on the interest already earned.

8. Display *Visual 6B.2: Compound Interest*. Walk the students through the steps of calculating interest over three years.

9. Reference the "After N Years" and "In general" formulas on Visual 6B.2. Discuss the following:
   - Predict the effect of the amount of the annual interest rate and the number of years on the value of the savings at the end. (*Both the annual interest rate and the number of years are directly related to the ending value; that is, the larger r and N, the greater is V.*)

10. Direct the students to Part 2 of Handout 6B.1. Have them use the compound interest formula to determine the ending savings value for each of the scenarios. Allow time for students to work and then review their answers.

Handout 6B.1: Calculating Interest: Part 2—Answer Key

Principal	Annual interest rate	# of Years	Value
$ 50	12%	6	*$ 98.69*
$200	8%	9	*$399.80*
$100	6%	12	*$201.22*
$ 20	4%	18	*$ 40.52*

11. Discuss the following:
   - What do you notice about the ending values relative to the initial values? (*The ending values are about double the initial values.*)

12. Display *Visual 6B.3: The Rule of 72*. Discuss the following:
   - The **Rule of 72** is a rule of thumb associated with the compound interest formula. It allows you to estimate the number of years it will take for a financial investment to double its value.
   - Divide 72 by the interest rate (percentage) to determine the approximate number of years it will take the investment to double its value.
   - The more times the value is allowed to double, the faster it will grow. (Go through the examples on the visual.)

13. Display *Visual 6B.4: Jack and Jill*. Instruct the students to use the Rule of 72 to estimate the ending values for Jack and Jill. Allow time for students to work and then review their answers. (Answers: *Jack: $40,000. Jill: $160,000*.)

14. Explain the following:
    - With an 8 percent annual interest rate, both Jack's and Jill's savings double every 9 years.
    - Jill leaves her savings in for 45 years and it doubles five times. She ends up with around $160,000.
    - Jack leaves his savings in for far fewer years—27 years. His doubles only three times, and he ends up with $40,000.
    - Although they both saved $5,000 and earn an 8 percent annual interest rate, Jill ends up with four times more money than Jack simply because she saved earlier.
    - What lesson is learned from Jack and Jill? (*Start saving early to take advantage of compound interest.*)

Closure

15. Discuss the following:
    - What is simple interest? (*Interest paid on the principal.*)
    - What is compound interest? (*Interest paid on the principal as well as the interest earned previously.*)
    - What is the Rule of 72? (*A rule of thumb associated with the compound interest formula that allows you to estimate the number of years it will take a financial investment to double its value*)

16. Explain the following:
    - While it can be difficult to put off spending, interest is the reward for saving.
    - Because of the power of compound interest, the reward for saving can be very large.
    - Jill gave up the opportunity to buy $5,000 worth of goods and services today, but she will be able to buy $160,000 worth of goods and services when she is 65 years of age. While inflation will likely reduce the real value of her money, she will still be able to buy and enjoy significantly more goods and services in the future than she could have bought with $5,000 today.
    - For Jack, the opportunity cost of waiting to save was very large—he ended up able to buy only a fourth of what Jill could buy even though he saved the same amount. For example, say you have a choice between buying a car now or saving that money at an 8 percent interest rate and buying a car later. If you buy the car now, that is what you have, one car. If you save, you could have enough money to buy two cars 9 years from now or four cars 18 years from now, or eight cars (or a house!) 27 years from now.

- What important factors should a saver consider to maximize the benefits of compound interest? (*Save often/regularly, start saving early, get the highest interest rate possible, and leave your savings in the account*)
- American humorist, Will Rogers, summed saving up this way: "The best way to double your money is to fold it in half and put it in your pocket."

Assessment

17. Distribute a copy of *Handout 6B.1: Assessment* to each student and allow time for students to work (or assign as homework).

Handout 6B.2: Assessment—Answer Key

Directions: Use what you have learned in this lesson to answer the following questions:

1. Imagine you receive a graduation gift of $5,000 from a wealthy uncle with a letter that encourages you to save the money for your old age. Also imagine that you are able to average 9% interest on the principal.
    a. How much (simple) interest will you receive on your savings after one year? (*$450*)
    b. What will the value of your savings be after that one year? (*$5,450*)
    c. What will the value be after 10 years (use the compound interest formula)? (*$11,836.82*)
    d. How many years will it take for your savings to double in value? (*8 years*)
    e. Say you were 18 years of age when you deposited the money and you will withdraw it at 66 years of age. How many times will the money have doubled in value during that time? (*6 times*)
    f. How much money will be in the account when you withdraw it at 66? (*$320,000*)

2. Now imagine you are 66 and have withdrawn your savings. You have decided to gift $5,000 to your young nephew or niece for graduation. Write a letter to accompany the check that explains why he or she should start saving early. (*The letter should explain that the best way to take advantage of compound interest is to save often/regularly, start early, get the highest interest rate possible, and leave the savings in the account*).

Visual 6B.1: Simple Interest

Ending Value (Balance) with Simple Interest

$$V = P(1 + r)$$

V = Value (balance) after 1 year

P = Principal (initial amount saved)

r = Annual interest rate

Principal	Annual interest rate	# of Years	Interest earned	Value
$ 50	5%	1		
$200	7%	1		
$ 60	10%	1		
$ 40	4%	1		

Visual 6B.2: Compound Interest

Compound Interest
Starting principal: $100

After 1 Year: $\$100 + \$100\,(0.08) = \$100\,(1 + 0.08) = \mathbf{\$108.00}$

$= \$100\,(1 + 0.08)$

After 2 Years: $\$108 + \$108\,(0.08) = \$108\,(1 + 0.08) = \mathbf{\$116.64}$

$= [\$100\,(1 + 0.08)](1 + 0.08)$

$= \$100\,(1 + 0.08)^2$

After 3 Years: $\$116.64 + \$116.64\,(0.08) = \$116.64\,(1 + 0.08) = \mathbf{\$125.97}$

$= [\$100\,(1 + 0.08)^2]\,(1 + 0.08)$

$= \$100\,(1 + 0.08)^3$

After N years: $= \$100\,(1 + 0.08)^N$

In general: $\mathbf{V = P\,(1 + r)^N}$

V = Value after N years

P = Principal

r = Annual interest rate

N = Number of years

Visual 6B.3: The Rule of 72

Years to double = 72/Interest rate

4%.....72/4 = 18 years

6%.....72/6 = 12 years

9%.....72/9 = 8 years

12%.....72/12 = 6 years

$1 saved at a 12% interest rate, after…

6 years = $2	30 years = $32
12 years = $4	36 years = $64
18 years = $8	42 years = $128
24 years = $16	48 years = $256

$4,000 saved at age 17 at a 12% annual interest rate, after…

48 years (age 65) = $1,024,000 = Millionaire

(It doubles 8 times!)

Visual 6B.4: Jack and Jill

Jack saves $5,000 when he is 38 years old and puts it in a savings account with an 8% annual interest rate.

Approximately how much money will he have in the account when he is 65 years old?

Jill saves $5,000 when she is 20 years old and puts it in a savings account with an 8% annual interest rate.

Approximately how much money will she have in the account when she is 65 years old?

Handout 6B.1: Calculating Interest

Name:_____

Part 1: Simple Interest

Practice using the simple interest formula with the saving options below. Calculate both the amount of interest earned and the value of the savings after one year.

$$V = P (1 + r)$$

V = Value (balance) after 1 year

P = Principal (initial amount saved)

r = Annual interest rate

Principal	Annual interest rate	# of Years	Interest earned	Value
$ 50	5%	1		
$200	7%	1		
$ 60	10%	1		
$ 40	4%	1		

Part 2: Compound Interest

Determine the ending value of savings in each of the following scenarios using the compound interest formula.

$$V = P (1 + r)^N$$

V = Value after N years

P = Principal

r = Annual interest rate

N = Number of years

Principal	Annual interest rate	# of Years	Value
$ 50	12%	6	
$200	8%	9	
$100	6%	12	
$ 20	4%	18	

Handout 6B.2: Assessment

Name:_____

Directions: Use what you have learned in this lesson to answer the following questions.

1. Imagine you receive a graduation gift of $5,000 from a wealthy uncle with a letter that encourages you to save the money for your old age. Also imagine that you are able to average 9% interest on the principal.

   a. How much (simple) interest will you receive on your savings after one year?

   _____

   b. What will the value of your savings be after that one year?

   _____

   c. What will the value be after 10 years (use the compound interest formula)?

   _____

   d. How many years will it take for your savings to double in value?

   _____

   e. Say you were 18 years of age when you deposited the money and you will withdraw it at 66 years of age. How many times will the money have doubled in value during that time?

   _____

   f. How much money will be in the account when you withdraw it at 66?

   _____

2. Now imagine you are 66 and have withdrawn your savings. You have decided to gift $5,000 to your young nephew or niece for graduation. Write a letter to accompany the check that explains why he or she should start saving early.

Standards and Benchmarks

National Standards for Financial Literacy

Standard 3: Saving. Saving is the part of income that people choose to set aside for future use. People save for different reasons during the course of their lives. People make different choices about how they save and how much they save. Time, interest rates, and inflation affect the value of savings.

- Benchmark: Grade 4

  2. When people save money, they give up the opportunity to spend that money to buy things now in order to buy things later.

- Benchmark: Grade 8

  4. When interest rates increase, people earn more on their savings and their savings grow more quickly.

  5. Principal is the initial amount of money upon which interest is paid.

  6. Compound interest is the interest that is earned not only on the principal but also on the interest already earned.

  7. The value of a person's savings in the future is determined by the amount saved and the interest rate. The earlier people begin to save, the more savings they will be able to accumulate, all other things equal, as a result of the power of compound interest.

- Benchmark: Grade 12

  1. People choose between immediate spending and saving for future consumption. Some people have a tendency to be impatient, choosing immediate spending over saving for the future.