Saving Money with Simple and Compound Interest

SUBMITTED BY: Nina Hoe, University of Pennsylvania

SUBJECT(S): Computation

GRADE LEVEL(S): 9, 10, 11, 12

OVERVIEW:

This lesson begins with a brief class discussion about saving money. Students are introduced to the concept of interest and different types of interest. In small groups, students will compare simple interest and compound interest through computations. The lesson closes with a class discussion about compound interest and when and where it is used.

NBEA STANDARD(S):

- Computation, I. Mathematical Foundations
- Computation, II. Number Relationships and Operations
- Computation, III. Patterns, Functions, and Algebra
- Computation, VI. Problem-Solving Applications

RELATED ARTICLES:

- “Why It Pays to Save: Knowing the Time Value of Money”
- “The Power of Plastic: What to Know about What You Owe”
- “Talking Money: Students Reflect on a Year of Spending, Valuing and Socking It Away for College”
- “Olivia Mitchell on Why Young Consumers Should Just Say No to Spending”
- “Educator Toolkit: Financial Literacy”
- “Cap, Gown, Cash: Get Smart with Your Graduation Gifts”

- "British Couponer Extraordinaire: Jordon Cox Is a Savings Sensation"
- "Blogger Zina Kumok: Saving Money Helped Me Prepare for My Future and Even Find Love"
- "A Trip to the Bank, Lollipops and World Savings Day"
- "9 Insights About Negative Interest Rates"

Common Core Standards:

- A-SSE.1. Interpret expressions that represent a quantity in terms of its context
- A-CED.1. Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*
- A-CED.2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- F-IF.1. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).
- F-IF.2. Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

Other Resources/Materials: Calculators

Class Discussion: (*5 mins*)

Have students read the WGYP article "Olivia Mitchell on Why Young Consumers Should Just Say No to Spending." Have students discuss in groups:

1. What are skills Olivia Mitchell recommends youth gain with regard to money?
2. What types of attitudes towards money does she advise?

(*5 mins*)

Saving Money

1. What are reasons that people save money?

2. What strategies do people use to save money?
3. When you save money, what are some different options for places and ways to save that money?

(*5 mins*)

One of the most basic ways to save money is by opening a **savings account**. A savings account, through a bank, allows individuals a safe and secure place to keep money. Additionally, in a savings account, individuals earn **interest** in exchange for allowing the bank to use, or borrow, their money.

Interest *is money paid regularly at a particular rate for the use of money lent, or for delaying the repayment of debt. Interest rates may range significantly, from 0% to much higher.*

Interest rates are closely tied to the amount of time that it takes the borrower to pay the money back. Discuss why it is advantageous to pay money back sooner rather than later.

Play the WGYP Glossary: Interest Rate

"The price a borrower pays for the use of money they do not own. Interest rates are normally expressed as a percentage rate over the period of one year. If the bank were to lower the interest rate from 8% to 7% on a loan of $100,000, the average interest payment will decrease from $8,000 to $7,000."

This is an **investment.** An investment is putting money into something with a generally secure, expected gain (in this case, the secure gain is the **interest**).

Simple Interest

$I = P \cdot r \cdot t$

Where **I** is the interest earned or owed in dollars, **P** is the principal amount deposited, lent, or borrowed, **r** is the interest rate (the percent) in decimal form, and **t** is the time in years that the money is in the account, lent or that the borrower takes to pay back the loan

Have students practice some simple calculations.

1. If you invested $1,000 for 5 years at an interest rate of 1.3%, how much would you make in interest?

Introduction to Compound Interest

1. Are there other types of interest other than simple interest?
2. How do other types of interests work?

Have students work in small groups or pairs.

(Have 2 two groups of students do the computations for Case 1 and 2 on the board side-by-side Have another 2 groups of students be responsible for columns 3 and 4 – questions 7 and 8.)

Activity: (*20 mins*)

Simple vs. Compound

Case 1:

1. You invest $1,000 in a savings account that earns 3% interest for 3 years.
a. Find the amount of simple interest that you would earn at the end of a 3-year period. [use P = Irt] ***($90)***
b. What is the total amount of money that you will have after this 3-year period? ***($1,090)***

Case 2:

2. You invest $1,000 in a savings account that earns 3% interest for 1 year.
a. Find the amount of simple interest that you would earn at the end of a 1-year period. [use P = Irt] ***($30)***
b. What is the total amount of money that you will have after this 1-year period ***($1,030)***

3. Take the total amount of money that you have from #2 part b and put it back into the same account for another year.
a. Find the amount of simple interest that you would earn at the end of a 1-year period. [use P = Irt] ***($31.83)***
b. What is the total amount of money that you will have after this 1-year period? ***($1,060.90)***

4. Take the total amount of money that you have from #3 part b and put it back into the same account for another year.
a. Find the amount of simple interest that you would earn at the end of a 1-year period. [use P = Irt] ***($30.93)***
b. What is the total amount of money that you will have after this 1-year period? ***($1,092.73)***
5. How does the total amount of money that you have after 3 years from Case 1 compare to the total amount of money you have from Case 2? ***($1,090 vs. $1,092.73 = $2.73 more. Imagine how much larger this could be over a longer period of time and with even more money.)***

In Case 2, the interest was **compounded**, meaning that the interest is earned not only on the principal but on the interest that was previously earned as well.

6. Complete the following table showing the balance of your account using compound interest. (The 3rd and 4th columns will be blank for right now.)

Time (years)	Balance (dollars)	Balance in terms of previous balance	Balance in terms of original balance
0	***$1,000***	***100%***	***100%***
1	***$1,030***	***103%***	***103%***
2	***$1,060.90***	***103%***	***106%***
3	***$1,092.73***	***103%***	***109%***

7. For successive years, what percent of the previous balance is the new balance?

a. Years 0 to 1: _____
b. Years 1 to 2: _____
c. Years 2 to 3: _____
d. What do you notice about the percentages?
e. Write each balance in terms of the previous balance (record in column 3).

8. Write each balance in terms of the original balance (record in column 4).

The general form for **compound interest** (an **exponential growth model**) is the equation:

$$A = P(1+\frac{r}{n})^{nt}$$

where, P is the principal amount, or the original amount of money before any growth occurs, r is the annual nominal interest rate or the **growth rate** in decimal form, n is the number of times the interest is compounded per year, t is the number of years, and A is the new amount.

Formula for Interest Compounded Annually:

$$A = P(1+r)^{t}$$

Formula for Interest Compounded Half Yearly:

$$A = P(1+\frac{r}{2})^{2t}$$

Formula for Interest Compounded Quarterly:

$$A = P(1+\frac{r}{4})^{4t}$$

Certificate of Deposit (CD)

A certificate of deposit is a promissory note issued by a bank. It is a time deposit that restricts holders from withdrawing funds on demand. Although it is still possible to withdraw the money, this action will often incur a penalty.

For example, let's say that you purchase a $10,000 CD with an interest rate of 5% compounded annually and a term of one year. At year's end, the CD will have grown to $10,500 ($10,000 * 1.05).

CDs of less than $100,000 are called "small CDs"; CDs for more than $100,000 are called "large CDs" or "jumbo CDs". Almost all large CDs, as well as some small CDs, are negotiable.

9. What is the growth rate from Case 2? ***(9%)***

10. You invest $650 into a savings account that earns 2.5% interest, compounded yearly. Write a model for the account balance y after t years. ***[A = $650(1 + .025)^t***

11. You have $1,000 that you want to invest for 5 years before you use the money towards a large purchase. Your bank offers a simple interest rate of 3% or an annual compound interest rate of 2.7%. Assuming that you will leave the money in 5 years, what is the best way to invest with your bank? ***(Simple – $150 in interest, Compound – $142.49)***

12. Based on the previous questions, do you think compounding interest annually, half yearly, or quarterly will yield more or less money? ***(The more it's compounded, the faster it grows)***

13. Calculate the annual, half yearly, and quarterly compounded interest associated with investing $5,000 for 4 years at an interest rate of 2.5%
a. Annually ***($5,125)***
b. Half Yearly ***($5,125.78)***
c. Quarterly ***($5,126.18)***

Tying It All Together:

Whole class discussion: (*10 mins*)

(Have students discuss these questions in small groups. Report back to the class about their answers.)

1. In terms of saving and investing money, what are the benefits of savings accounts?
2. How are savings accounts different from CDs?
3. What are the advantages and disadvantages of CDs over savings accounts?
4. What is the difference between simple and compound interest?
5. If you were going to deposit money into a savings account, what kinds of questions would you ask about the interest rates/types of interest offered?

What Worked and What I Would Do Differently:

Sources:

Carnegie Learning (2006): "Algebra 1"