Basic Mathematics Skills: Simple and Compound Interest

Unit: Basic Skills for Family and Consumer Sciences

Problem Area: Apply Mathematics Skills

Lesson: Basic Mathematics Skills: Simple and Compound Interest

Student Learning Objectives. Instruction in this lesson should result in students achieving the following objectives:

- **1** Calculate simple interest.
- **2** Calculate compound interest.
- **3** Calculate credit card and loan interest payments.

List of Resources. The following resources may be useful in teaching this lesson:

- Slater, Jeff. *Practical Business Math Procedures*, 8th ed. McGraw-Hill Irwin, 2006.
- "Relating Interest to Percentages," *Lesson Plans Page*. Accessed June 21, 2008. < http://www.lessonplanspage.com/printables/PMathCreditCard PaymentsSimpleInterestAndPercentages9.htm>.

"Understanding Credit Card Interest," *Investopedia*. Accessed June 21, 2008. http://www.investopedia.com/articles/01/061301.asp.



List of Equipment, Tools, Supplies, and Facilities

- ✓ Overhead or PowerPoint projector
- ✓ Visual(s) from accompanying master(s)
- ✓ Copies of sample test, lab sheet(s), and/or other items designed for duplication
- ✓ Materials listed on duplicated items
- ✓ Computers with printers and Internet access
- ✓ Classroom resource and reference materials

Terms. The following terms are presented in this lesson (shown in bold italics):

- compound interest
- principal
- rate
- simple interest

Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situation. A possible approach is included here.

Did you know that, in 2004, the average credit card debt in a typical American household was over \$5,000.00? And, that the average rate of interest on this debt was 17 to 20 percent? Use the following questions and others to conduct a brainstorming session that would assess the students' awareness and knowledge of simple and compound interest.

- What does it cost to have a credit card?
- What is the best way to finance a car? a house? a business?
- When someone says they are "financially set for the future," what do they mean?
- How much would you need to save to pay for your postsecondary education? a vacation?

SUMMARY OF CONTENT AND TEACHING STRATEGIES

Objective 1: Calculate simple interest.

Anticipated Problem: How is simple interest calculated?

- I. Simple interest
 - A. **Simple interest** is the fee paid on the original loan or deposit. Interest is often referred to as an annual percentage rate and is the fee paid for the privilege of borrowing money. The fee is the price paid to spend money today that it would typically take time to accumulate.
 - B. The simple interest formula is $I = p \times r \times t$, where I = interest, p = principal (the original amount invested or loaned), r = rate (the percent used to determine the interest), and t = time (in years).
 - C. Given three of the four variables—interest, principal, rate, and time— one can solve for the fourth variable.
 - 1. $p = I \div (r \times t)$
 - 2. $r = I \div (p \times t)$
 - 3. $t = I \div (p \times r)$

Many techniques can be used to help students master this objective. As an example, use VM–A to describe the steps in determining simple interest, or principal, or rate, or time and have students practice these calculations using LS–A.

Objective 2: Calculate compound interest.

Anticipated Problem: How do you calculate compound interest?

- II. Compound interest
 - A. **Compound interest** is interest that is calculated on the principal plus interest.
 - B. Steps for calculating compound interest include:
 - 1. Calculate the simple interest and add it to the principal
 - 2. Calculate the simple interest on the new principal plus interest
 - 3. Continue for the given time period
 - C. Formula for compound interest: $A = p (1 + r) \land n$, where A is the amount of money including principal plus interest, p is the principal, r is the rate per period, and n is the number of times compounded.

Many techniques can be used to help students master this objective. As an example, use VM–B to describe the steps in determining compound interest and practice with LS–B.

Objective 3: Calculate credit card and loan interest payments.

Anticipated Problem: How do you calculate interest on credit cards and loans?

- III. Credit card and loan interest and payments
 - A. Compound interest is calculated monthly
 - B. Minimum monthly payments are 3 percent or \$20, whichever is higher

Many techniques can be used to help students master this objective. As an example, use VM–B to describe the steps in determining compound interest and use it to practice with LS–B.

Review/Summary. Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. Questions at the ends of chapters in the textbook may also be used in the review/ summary.

Application. Use the included visual masters and lab sheets to apply the information presented in the lesson.

Evaluation. Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance on the application activities. A sample written test is provided.

Answers to Sample Test:

Part One: Short Answer

- 1. Simple interest is calculated only on the principal, whereas compound interest is calculated on the principal plus interest.
- 2. Since most credit cards have annual percentage rates of 21 percent or higher, which is 1.75 percent monthly, by paying a minimum of 3 percent, it will take a very long time to pay off the debt.
- 3. The compound interest formula calculates the amount of money that has accumulated. To calculate the interest, take the amount (A) and subtract the principal (p).

Part Two: True/False

1. F

- 2. F
- 3. T
- 4. T
- 5. T
- 6. F

Part Three: Multiple Choice

- 1. c
- 2. a
- З. а
- 4. c
- 5. a
- 6. c
- 7. b

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Part One: Short Answer

Instructions: Complete the following.

1. Explain the difference between simple interest and compound interest.

2. What is the likely outcome of making only the minimum monthly payment on a credit card?

3. How is interest determined using the compound interest formula?



Part Two: True/False

Instructions: Write T for true and F for false.

- 1. In the simple interest formula, "time" can be any unit—years, months, days, and so on.
- 2. In the compound interest formula, the "rate" is always annual.
- 3. If you are depositing money in a savings account, you will earn more interest if the interest is compounded instead of calculated as simple interest.
 - ___4. Interest increases as the number of compounding periods increases.
- 5. When making payments on a credit card, it is acceptable to make only the minimum monthly payment.
 - 6. Credit card and loan payments are calculated using the simple interest formula.

Part Three: Multiple Choice

Instructions: Write the letter of the correct answer.

- ___1. The simple interest on \$400.00 at $2\frac{1}{4}$ % for 3 years is _____.
 - a. \$2,700.00
 - b. \$270.00
 - c. \$27.00
 - d. \$25.68
 - 2. The simple interest on \$7,900.00 at 51/8% for 30 months is _____.
 - a. \$1,012.19
 - b. \$12,146.25
 - c. \$10,123.05
 - d. \$101,218.75
- ___3. The amount of money in your account if you invested \$6,000.00 at 8% interest compounded daily for 2 years would be _____.
 - a. \$7,040.94
 - b. \$1,040.94
 - c. \$6,998.40
 - d. \$6,002.63
- __4. The amount of compound interest that would accrue if you invested \$12,300.00 at 63/4% interest compounded monthly for 5 years is _____.
 - a. \$17,221.41
 - b. \$12,649.85
 - c. \$4,921.41
 - d. \$13,158.41

- _5. The first month's interest on a credit card with an annual percentage rate of 22% compounded monthly that has a balance of \$3,200.00 is ____.
 - a. \$58.67
 - b. \$704.00
 - c. \$779.51
 - d. \$5,248.00
- __6. The total interest for a home mortgage of \$175,000 at 4³/₄% interest compounded daily for 15 years is _____.
 - a. \$8,512.52
 - b. \$356,822.91
 - c. \$181,822.91
 - d. \$176,033.47
- __7. The total amount paid to a bank on a car loan of \$22,000 at 5% interest compounded quarterly for 5 years is _____.
 - a. \$6,204.82
 - b. \$28,204.82
 - c. \$28,078.19
 - d. \$23,409.81



SIMPLE INTEREST

Formula to find interest: $I = p \times r \times t$

Example A: Find the Interest

What is the simple interest on \$500.00 deposited at $4\frac{3}{4}\%$ annual simple interest for five years?

- 1. Change $4\frac{3}{4}\%$ to a decimal: $4\frac{3}{4}\% = 0.0475$
- 2. Substitute the given values for p, r, and t

a. I = $$500 \times 0.0475 \times 5$

- b. Complete the multiplication calculations
- 3. Answer: I = \$118.75



Example B: Find the Interest

What is the simple interest on a \$1,500.00 loan at $5\frac{1}{2}$ % annual simple interest for ten years?

- 1. Change $5\frac{1}{2}\%$ to a decimal: $5\frac{1}{2}\% = 0.055$
- 2. Substitute the given values for p, r, and t

a. I = $$1,500 \times 0.055 \times 10$

b. Complete the multiplication calculations

• Formula to find the principal: $p = I \div (r \times t)$

- Formula to find the rate: $r = I \div (p \times t)$
- Formula to find the time: $t = I \div (p \times r)$

Example C: Find the Principal

To earn \$300 in interest in 5 years, how much do you need to invest at $3\frac{1}{2}$ % simple interest?

Given the rate, interest, and time, find the principal.

- 1. Change $3\frac{1}{2}\%$ to a decimal: $3\frac{1}{2}\% = 0.035$
- 2. Substitute the given values for I, r, and t

a. $p = I \div (r \times t)$

- b. $p = $300 \div (0.035 \times 5)$
- 3. Answer (simplified): p = \$1,714.29

Example D: Find the Rate

What is the simple interest rate of an account with an original balance of \$10,000.00 that has a \$10,600.00 balance at the end of one year?

- 1. Find the interest for the year. Since \$10,600 is principal plus interest, subtract the principal (\$10,000) from the balance to find the interest. The interest is \$600.00.
- 2. Given the interest, principal, and time, find the rate.

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a. Substitute the given values for I, p, and t.
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 $\mathsf{r} = \mathsf{I} \div (\mathsf{p} \times \mathsf{t})$

$$r =$$
\$600 \div (\$10,000 \times 1)

b. Simplify: r = 0.06 = 6%

How much time would it take for \$20,000, invested at 5% simple interest, to earn \$5,000.00 in interest?

- 1. Change 5% to a decimal: 5% = 0.05
- 2. Substitute the given values for I, p, and r

 $\mathsf{t} = \mathsf{I} \div (\mathsf{p} \times \mathsf{r})$

- $t = \$5,000 \div (\$20,000 \times 0.05)$
- 3. Simplify: t = 5 years

COMPOUND INTEREST

You deposit \$1,000.00 in a savings account that pays 3% interest compounded yearly. How much interest would you earn for 1 year? How much interest would you earn for each of the years 2 through 10? What would the savings account balance be at the end of 10 years?

Year	Principal	Rate	Time	Interest
1	\$1,000.00	0.03	1	\$30.00
2	\$1,030.00	0.03	1	\$30.90
3	\$1,060.90	0.03	1	\$31.83
4	\$1,092.73	0.03	1	\$32.78
5	\$1,125.51	0.03	1	\$33.77
6	\$1,159.28	0.03	1	\$34.78
7	\$1,194.06	0.03	1	\$35.82
8	\$1,229.88	0.03	1	\$36.90
9	\$1,266.78	0.03	1	\$38.00
10	\$1,304.78	0.03	1	\$39.14

At the end of ten years you would have a balance of \$1,343.92.



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Use the compound interest formula to solve the same problem. You invest \$1,000.00 at 3% interest compounded yearly for 10 years.

- 1. Determine the interest rate per period (r = 0.03 \div 1).
- 2. Determine the number of times compounded (n = 1 time per year \times 10 years = 10).
- 3. Substitute and solve for A.

 $A = p (1 + r) ^ n$ $A = $1,000.00 (1 + 0.03) ^ 10$ A = \$1,343.92

If you invest \$2,500.00 at 6% compounded quarterly, how much will you have in the account in 5 years?

- 1. Determine the interest rate per period (r = $0.06 \div 4$).
- 2. Determine the number of times compounded (n = 4 times per year \times 5 years = 20).
- 3. Substitute and solve for A.

$$A = p(1 + r) \land n$$

$$A = $2,500 (1 + 0.06 \div 4) \land 20$$

$$A = $3,367.14$$

If you invest \$5,000 at $5\frac{1}{2}$ % interest compounded semi-annually, how much will you have in the account in 10 years?

- 1. Determine the interest rate per period (r = 0.055 \div 2).
- 2. Determine the number of times compounded (n = 2 times per year \times 10 years = 20).
- 3. Substitute and solve for A.

 $A = p(1 + r) ^ n$ $A = $5,000(1 + 0.055 \div 2) ^ 20$ A = \$8,602.14

If you invest \$7,800 at 3% interest compounded daily, how much will you have in the account in 3 years?

- 1. Determine the interest rate per period (r = $0.03 \div 365$).
- 2. Determine the number of times compounded (n = 365 times per year \times 3 years = 1,095).
- 3. Substitute and solve for A.

 $A = p(1 + r) \land n$ A = \$7,800 (1 + 0.03 ÷ 365) \land 1,095

A = \$8,534.53

Crystal opened a credit card with Comfort Furniture Shop with a 21% annual interest rate compounded monthly. Each month the minimum payment is 3% or \$20, whichever is higher. The leather sofa and love seat that she purchased cost \$1,948.50, including tax. She budgeted three monthly payments of \$350.00 and then would pay the minimum for the next three months. Determine her monthly minimums and amount owed for the first six months.

Month	New Balance	Minimum	Paid	Owed
1	\$1,948.50	(0.03 × \$1,948.50 = \$58.46) so \$20	\$350.00	\$1,598.50
2	(\$1,598.50)(1 + 0.21 ÷ 12) = \$1,626.47	(0.03 × \$1,626.47 = \$48.79) so \$20	\$350.00	\$1,276.47
3	(\$1,276.47)(1 + 0.21 ÷ 12) = \$1,298.81	(0.03 × \$1,298.81 = \$38.96) so \$20	\$350.00	\$948.81
4	(\$948.81)(1 + 0.21 ÷ 12) = \$965.41	(0.03 × \$965.41 = \$28.96)	\$28.96	\$936.45
5	(\$936.45)(1 + 0.21 ÷ 12) = \$952.84	(0.03 × \$952.84 = \$28.58)	\$28.58	\$924.26
6	(\$924.26)(1 + 0.21 ÷ 12) = \$940.43	(0.03 × \$940.43 = \$28.21)	\$28.21	\$912.22

Name_____

Simple Interest

Purpose

The purpose of this activity is to demonstrate your understanding of simple interest.

Objectives

- 1. Determine simple interest.
- 2. Determine the principal, rate, or time given the simple interest and two of the three variables.

Materials

- Iab sheet
- writing utensil
- calculator

Procedure

- 1. In Part I, fill in the simple interest in the table using the formula, $I = p \times r \times t$.
- 2. In Part II, find the unknown using one of the following formulas: $p = I \div (r \times t)$, $r = I \div (p \times t)$, $t = I \div (p \times r)$.

Part I: Find the simple interest for items 1 through 9 in the table.

	Principal	Rate	Time	Simple interest
1.	\$500.00	6%	2 years	
2.	\$1,200.00	5¾%	18 months	
3.	\$150.00	41⁄4%	5 years	
4.	\$10,000.00	3%	4 years	
5.	\$1,500.00	3%	3 months	
6.	\$1,500.00	31⁄8%	6 months	
7.	\$1,500.00	31⁄8%	1 year	
8.	\$1,500.00	31/8%	2 years	
9.	\$1,500.00	31/8%	3 years	

Part II: Find the unknown variable.

- 1. Find p given the interest is \$168.75, the rate is $2\frac{1}{4}$ %, and the time is 2 years.
- 2. Find r given the interest is \$1,443.75, the principal is \$8,250.00, and the time is 5 years.
- 3. Find t given the interest is \$343.75, the principal is \$5,500.00, and the rate is 31%%.

Simple Interest

Part I: Find the simple interest for each of the following.

	Principal	Rate	Time	Simple Interest
1.	\$500.00	6%	2 years	(500)(0.06)(2) = \$60
2.	\$1,200.00	5¾%	18 months	(1,200)(0.0575)(1.5) = \$103.50
3.	\$150.00	41⁄4%	5 years	(150)(0.0425)(5) = \$31.88
4.	\$10,000.00	3%	4 years	(10,000)(0.03)(4) = \$1200.00
5.	\$1,500.00	31⁄8%	3 months	$(1,500)(0.03125)(3 \div 12) = $ \$11.72
6.	\$1,500.00	31⁄8%	6 months $(1,500)(0.03125)(6 \div 12) = $23.$	
7.	\$1,500.00	31⁄8%	1 year	(1,500)(0.03125)(1) = \$46.88
8.	\$1,500.00	31⁄8%	2 years	(1,500)(0.03125)(2) = \$93.75
9.	\$1,500.00	31/8%	3 years	(1,500)(0.03125)(3) = \$140.63

Part II: Find the unknown variable.

1. Find p given the interest is \$168.75, the rate is $2\frac{1}{4}$ %, and the time is 2 years.

 $p = I \div (r \times t)$

 $p = \$168.75 \div (0.0225 \times 2) = \$3,750$

2. Find r given the interest is \$1,443.75, the principal is \$8,250, and the time is 5 years.

 $\begin{aligned} r &= I \div (p \times t) \\ r &= \$1,443.75 \div (8,250 \times 5) = 0.035 \\ r &= 3.5\% \end{aligned}$

3. Find t given the interest is \$343.75, the principal is \$5,500, and the rate is 31/8%.

$$t = I \div (p \times r)$$

 $t = \$343.75 \div (5,500 \times 0.03125)$

t = 2 years

Name

Compound Interest

Purpose

The purpose of this activity is to demonstrate your understanding of compound interest.

Objectives

- 1. Determine compound interest.
- 2. Calculate interest on credit cards and loans.

Materials

- Iab sheet
- writing utensil
- calculator

Procedure

- 1. In Part I, determine the compound interest and fill in the table using the formula A = $p(1 + r) \uparrow n$.
- 2. In Part II, determine the credit card or loan interest using the compound interest formula.

Part I: Fill in the missing columns in the following table.

	Compounding Period	Principal	Annual Rate	Time	Interest Rate per Period	Number of Periods	Amount of Interest Paid
1.	Semiannually	\$5,000.00	6%	2 years			
2.	Quarterly	\$3,000.00	4%	4 years			
3.	Monthly	\$8,000.00	3%	5 years			



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4.	Daily	\$2,500.00	41/2%	8 years		

Part II: Determine the unknowns on the given credit cards or loans.

 Calculate the first three months balance on a credit card with a beginning balance of \$5,000.00 that charges a 23.8% annual percentage rate. Jennifer made payments of \$500.00, \$200.00, and \$150.00 for the first three months.

2. Calculate the total amount paid to the bank on a car loan of \$41,000.00 at $7\frac{1}{4}\%$ interest compounded daily for 5 years.

3. Calculate the total amount paid to the mortgage company on a home mortgage of \$265,000.00 at 5% interest compounded monthly for 15 years.

Compound Interest

Part I: Fill in the missing amounts in the following table.

	Compounding Period	Principal	Annual Rate	Time	Interest Rate per Period	Number of Periods	Amount of Interest Paid
1.	Semiannually	\$5,000.00	6%	2 years	0.06 ÷ 12	2 × 2 = 4	\$627.54
2.	Quarterly	\$3,000.00	4%	4 years	0.04 ÷ 4	4 × 4 = 16	\$517.74
3.	Monthly	\$8,000.00	3%	5 years	0.03 ÷ 12	12 × 5 = 60	\$1,292.93
4.	Daily	\$2,500.00	41⁄2%	8 years	0.045 ÷ 365	365 × 8 = 2,920	\$1,083.24

Use the formula $A = P(1 + r)^n$

1. $A = \$5,000.00 (1 + 0.06 \div 12) \land 4$ A = \$5,627.54 I = \$5,627.54 - \$5,000 = \$627.542. $A = \$3,000.00(1 + 0.04 \div 4) \land 16$ A = \$3,517.74 I = \$3,517.74 - \$3,000 = \$517.743. $A = \$8,000.00(1 + 0.03 \div 12) \land 60$ A = \$9,292.73 I = \$9,292.93 - \$8,000 = \$1,292.934. $A = \$2,500.00(1 + .045 \div 365) \land 2920$ A = \$3583.24I = \$3583.24 - \$2,500 = \$1083.24

Part II: Determine the unknowns on the given credit cards or loans.

 Calculate the first three months balance on a credit card with a beginning balance of \$5,000 that charges a 23.8% annual percentage rate. Jennifer made payments of \$500.00, \$200.00, and \$150.00 for the first three months.

Month 1: Jennifer owed \$5,000.00 and made one payment of \$500.00. Balance at the end of the first month was \$4,500.00

Month 2: $A = $4,500.00(1 + 0.238 \div 12)$

A = \$4,589.25

Jennifer made a payment of \$200.00

Balance at the end of the second month was \$4,389.25

Month 3: $A = $4,389.25(1 + 0.238 \div 12)$

A = \$4,476.30

Jennifer made a payment of \$150.00

Balance at the end of the third month was \$4,326.30

6. Calculate the total amount paid to the bank on a car loan of 41,000.00 at $7\frac{1}{4}\%$ interest compounded daily for 5 years.

 $A = $41,000(1 + 0.0725 \div 365) \land (365 \times 5)$

A = \$58,911.49

7. Calculate the total amount paid to the mortgage company on a home mortgage of \$265,000.00 at 5% interest compounded monthly for 15 years.

 $A = $265,000(1 + 0.05 \div 12) \land (12 \times 15)$

A = \$560, 131.54