

Calculating the Cost of Credit
**CTE Lesson Aligned with TN State Standards for Literacy
 in Science and Technology**

This resource is best for:

Teachers of:	Agricultural Business and Finance	Career Cluster:	Agribusiness
Addressing Standard(s):	Standards 5 & 6	Grade-Band:	11-12
In alignment with CTSO:	FFA: www.tnffa.org Click here for specific guidelines.	CTSO Event: (if applicable)	Agricultural Issues, Agricultural Sales, Agriscience Fair, Cooperative Development Challenge, Farm Business Management, Marketing Plan

Learning Objective: The goal of this activity is to develop a student’s understanding of and ability to perform interest rate calculations. The skills reflect proficiency in mathematics standards for high school. Teachers can use this activity to develop an understanding of the basic formulas and procedures for calculating simple and compound interest rates for credit card debt and loans for personal or agribusiness activities. Discussions in class and practice exercises coordinated in class help students learn the various methods of calculating credit costs and demonstrate the results of decisions made concerning individual and business borrowing. Exercises will center on math calculations and the impact of higher interest rates and longer payment periods on the ability to repay a loan earlier at greater savings.

The following should be used during this teaching:

- The math standards for Tennessee 9-12 Mathematics, found at <http://www.tncore.org/math/>.

CTSO Competition Overview: Participants in several FFA competitive events may expect a connection to calculating interest. Performance indicators may include the following:

- Analyze farm/ranch business management information.
- Apply economic principles and concepts of cooperative business management to the decision-making process.
- Apply economic principles and concepts of farm business management to the decision-making process.
- Compute key banking calculations
- Evaluate farm business management decisions.
- Explain the responsibilities of maintaining sound finances.

Visit the Tennessee FFA websites for event guidelines.

<https://www.tnffa.org/page.aspx?ID=72>

Tennessee CTE Standards addressed by task	
Agricultural Business and Finance	<p>5) Apply principles of consumer finance, savings, investing, and loans to develop personal and agribusiness budgets. (TN Math N-Q, A-SSE)</p> <p>6) Using visual representations and mathematical equations, compare and contrast the differences between personal, business, and farm financing, including but not limited to sources, terms, and available risk management strategies (such as insurance, investments, and commodity trading). Using quantitative reasoning and appropriate units, calculate simple and compound interest for a given financing option. (TN Reading 2, 4, 7; TN Math N-Q, A- CED, A-REI)</p>

TN State Standards for Mathematical Content	TN State Standards for Mathematical Practice
<p>N-NQ 1. Uses units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>2. Define appropriate quantities for the purpose of descriptive modeling.</p> <p>3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p> <p>A-CED 4. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.</p> <p>A-SSE 1. Interpret expressions that represent a quantity in terms of its context.</p> <ol style="list-style-type: none"> Interpret parts of an expression, such as terms, factors, and coefficients. Interpret complicated expressions by viewing one or more of their parts as a single entity. <p>A-REI 1. Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.</p> <p>2. Solve simple rational and radical equations in one variable, and give</p>	<ol style="list-style-type: none"> 1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique the reasoning of others. 4. Model with mathematics. 5. Use appropriate tools strategically. 6. Attend to precision. 7. Look for and make use of structure. 8. Look for and express regularity in repeated reasoning.

<p>examples showing how extraneous solutions may arise.</p> <p>3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.</p> <p>4. Solve quadratic equations in one variable.</p> <p>a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.</p>	
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<p>Essential Understandings:</p>
<ul style="list-style-type: none"> • The amount of interest a lender receives is based on the interest rate. • An interest rate is the cost of borrowing money, expressed as a percentage of the amount borrowed, usually over a period of one year. • Interest is either paid as simple interest or compound interest.

<p>Teacher Notes:</p>
<p>Students will need to know:</p> <ul style="list-style-type: none"> • Interest is the amount charged to a borrower for the use of the lender’s money. • If you are the borrower, you must repay more than you borrowed to compensate the lender for the time you used the money and the risk the lender incurs with the possibility of the borrower not repaying (defaulting). • In the same way, if you place some of your money in the bank or in another investment, you expect the value you receive for allowing others the use of your money would be fair compensation.

Task: Calculating the cost of credit

Number & Quantity/Algebra

A. Calculate Simple interest.

- With simple interest, the amount of interest is calculated at the end of each year based on the total amount loaned.

The formula for determining simple interest is

$$I = Prt \text{ (Interest = Principal x Interest Rate x Amount of Time)}$$

I = interest

P = principal

r = interest rate

t = time (the length of the loan or investment in years)

Adding the interest, I , to the principal, P , will yield the total amount that is earned from the investment or that needs to be repaid.

Example: If \$3,000 is loaned at a 5 percent simple interest, at the end of two years \$300 has been earned/charged.

Work shown: $\$3,000 \times 0.05 \times 2 = \300

A. Problems

Calculate the following simple interest problems:

1. You just purchased a used tractor for \$4,500 from your next door neighbor. He agreed to let you make payments for three years with a simple interest of 6 percent. How much interest will you pay?
2. You are interested in buying a flat screen TV from a local electronic store. The cost of the TV is \$2,500. You plan to make a down payment of \$300. You must finance the rest at 4 percent interest for two years. How much will the TV cost at the end of two years?
3. You are expanding your inventory by agreeing to purchase a new product in the amount of \$6,000. The loan must be paid in six months at a 3 percent interest rate. How much will you pay in interest over the term of the loan?

B. Calculate Compound Interest.

- Compound interest pays interest not only on the total amount borrowed but also on the interest that has been earned.

The formula for determining compound interest is

$$A = P(1 + r)^n$$

P = Principal

R = annual rate of interest (percentage)

N = number of years the amount is deposited or borrowed for

A = the amount of money accumulated after n years, including interest

- Compound interest is paid on the original principal and the accumulated past interest.
- If the interest is compounded annually, the interest at the end of the first year is added to the amount loaned and that amount is used to calculate the interest earned at the end of the second year.

Example: If \$1,000 is loaned at 5 percent compounded interest for two years, rather than \$100 earned from simple interest, the lender now has earned \$102.50 of interest.

Work Shown: Year 1 $\$1,000 \times .05 = \50.00

Year 2 $\$1,050 \times .05 = \52.50

$\$50.00 + 52.50 = \102.50 The total of compound interest at the end of two years.

- Interest can be compounded at various times. It could be compounded annually, quarterly, monthly or daily.
- The more frequent the compounding, the higher the amount of interest paid.

- Frequent Compounding of Interest

Annually = $P \times (1 + r)$

Quarterly = $P(1 + r/4)^4$

Monthly = $P (1 + r/12)^{12}$

B. Problems

Calculate the following Compound interest problems:

1. If we borrow \$250,000 today to replace outdated equipment and the terms are 8 percent for five years compounded annually, what is the total cost of the equipment purchase?
2. If we invest \$2,000 a month in an employee retirement account at an annual rate of 6 percent compounded quarterly, what will be the value of the fund in 10 years?
3. If Jennifer wants to earn at least \$10,000 interest in the next five years and current interest rates are 4 percent compounded annually, how much should she invest?

C. Problem

Decision Time: Calculate the cost of interest on the following credit offerings for an installment loan. Determine the total cost of extending credit (using simple interest) for the life of each loan and the monthly payment amount. Make a recommendation for which interest rate provides the best cost savings.

	Loan Package One	Loan Package Two	Loan Package Three
Amount Borrowed	\$20,000	\$20,000	\$20,000
Loan Period	10 years	5 years	3 years
Interest Rate	20%	17%	10%
Total cost of Loan			
Monthly Payment Amount			

Explore Phase

Assessing and Advancing Questions

TN Math

Lesson Answer Key:

Section A Problems 1-3 (located on page 4)

- A.
1. $I = P \times r \times t$ $\$4,500 \times .06 \times 3 = \underline{\$810.00}$
Total Interest
 2. $\$2,500 - 300 = 2,200$
 $I = P \times r \times t$ $2,200 \times .04 \times 2 = 176.00$
 $\$176.00 + 2,200 = \underline{\$2,376.00}$ Total cost of TV
 3. $I = 6,000 \times .03 \times .50 = \underline{\$90.00}$ Total Interest

Section B Problems 1-3 (located on pages 4-5)

- B.
1. \$ 377,332.02 Compounded Annually
 2. \$332,486.09 Value of Fund

Allow students time to work through their problems, then ask questions.

Sample Questions:

- What is the problem asking you?
- Is the problem asking you for total interest or total cost of the product?
- Describe what each number in your formula represents.
- Talk me through your calculations.
- Talk me through how you solved the equation.
- How does your equation relate to the scenario?

<p>3. $\\$10,000 = P(1 + .04)^5$ $P = \\$8,219.29$</p> <p>Section C Problems (located on page 6)</p> <p>C. Package One – Total Loan Cost \$60,000 Monthly Payment \$500</p> <p>Package Two – Total Loan Cost \$37,000 Monthly Payment \$ 616</p> <p>Package Three – Total Loan Cost \$26,000 Monthly Loan Payment \$712</p>	<p>Did you remember to subtract the down payment from the amount of the purchase price?</p> <p>How would you figure the amount of for only six months as the period of loan?</p> <p>Tell me why you multiplied with the fraction .05?</p> <p>Are there circumstances in which the higher overall cost of the loan may be justified?</p>
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Potential Lesson Plan Design:

Lesson Phases	Content/ Routines
<p style="text-align: center;">Set-Up of the Task Introduction</p>	<ul style="list-style-type: none"> • Open with question involving the purchase of a used tractor and possible loan options. • Have students identify current interest rates offered by local lending institutions by using available resources from newspapers, ads, brochures, and internet searches. • Ask students how they can calculate the best possible interest rates when making purchasing decisions. Provide text sources whereby students can study formulas and strategies used to calculate interest rates. • Provide formulas for calculating interest rates. • Using formula for simple interest rate calculation, teacher demonstrates calculation. • Teacher demonstrates compound interest rate calculations. • Teacher demonstrates comparison method between total interests paid vs monthly payment options.
<p style="text-align: center;">The Explore Phase/ Private Work Time Generate Solutions</p>	<ul style="list-style-type: none"> • Have students define the differences between simple and compound interest. • Students work on problems individually using simple rate calculations. • Students work on compound interest rate problems individually. • Students work on interest rate comparison loan shopping problem individually. • Teacher MONITORS the class during this phase and selects examples from students for the Share Discuss Phase based on: <ul style="list-style-type: none"> ○ Different solutions paths to the same task ○ Different representations ○ Errors ○ Misconceptions
<p style="text-align: center;">The Explore Phase/Small Group Problem Solving</p> <ol style="list-style-type: none"> 1. Generate & Compare Solutions 2. Assess and Advance Student Learning 	<ul style="list-style-type: none"> • Students work on problems together using simple rate calculations. • Students work on compound interest rate problems together. • Students work on interest rate comparison loan shopping problem in group. • Students discuss how they worked through problems together.
<p style="text-align: center;">Share Discuss and Analyze Phase of the Lesson</p>	<ul style="list-style-type: none"> • SHARE – Students discuss how they worked through problems, students explain their methods, repeat others ideas, put ideas into their own words add on to ideas and ask for clarification.

<ol style="list-style-type: none"> 1. Share and Model 2. Compare Solutions 3. Focus the Discussion on Key Mathematical Ideas 4. Engage in Quick Write/Exit Slip 	<ul style="list-style-type: none"> • Repeat the cycle for each solution path. • COMPARE – Students discuss similarities and differences between solution paths. • FOCUS – Discuss the meaning of mathematical ideas in each representation. • REFLECT – Engage students in a Quick Write/Exit Slip or a discussion of the process. Have students turn to a seat partner and explain the difference between simple and compound interest.
<p>Close</p>	<ul style="list-style-type: none"> • During the unit covering interest and the time value of money, you have learned the meaning of interest and how interest rates affect investment decisions. You have identified the advantages and disadvantages and the costs involved in using credit. Today you have learned how to calculate interest rates used for both investments and loans. You have learned to calculate simple and compound interest using the formulas provided.
<p>Homework</p>	<ul style="list-style-type: none"> • TEAMWORK / Homework Activity: Under the <u>Truth in Lending Act</u>, information on credit and finance terms must be made “clearly and conspicuously” to consumers by a business. This means the disclosures must be legible and reasonably understandable. Locate examples of credit information in newspaper and magazine ads. Discuss with your small group members whether you believe the examples meet the legal requirement or not. Share with class findings.

Additional Resources

Check these sites for easy-to-use calculators for computing the time value of money and other financial computations:

- www.e-farmcredit.com/Tools/LoanPaymentCalculator/tabid/84/Default.aspx
- <http://www.calculator.net>
- www.math.about.com/library
- www.finance.cch.com/tools/calcs.asp
- www.moneychimp.com/calculator/compound_interest_calculator.htm

Note: Social, ethnic, racial, religious, and gender bias is best determined at the local level where educators have in-depth knowledge of the culture and values of the community in which students live. TDOE asks local districts to review these materials for social, ethnic, racial, religious, and gender bias before use in local schools.