NCEA Math Lesson Plan

Grade: 9-12 **Subject:** Mathematics

Domain:
Algebra 3/Pre-Calculus

Topic:
Exponential Growth and Compound Interest

Standard Number(s) and Description:
A.SSE.1.B Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret $P(1 + r)^n$ as the product of P and a factor not depending on P.

F.IF.8.B Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as $y = (1.02)t$, $y = (0.97)t$, $y = (1.01)12t$, $y = (1.2)t/10$, and classify them as representing exponential growth or decay.

F.LE.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

F.LE.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.

F.LE.4 For exponential models, express as a logarithm the solution to $ab^{ct} = d$ where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.

F.LE.5 Interpret the parameters in a linear or exponential function in terms of a context.

S.ID.6.A Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.

Vocabulary to be Highlighted:

Mathematical Practices (#):
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.

Essential Questions:

How do we determine if a loan is reasonable?
How do we create, test, and validate a model?

Materials/Tools (include technology):
Google Docs
FAFSA handout (below)

Connections to Other Math Domains:

Connections to Other Subject Areas:
Financial planning
College choice

Catholic Identity Component:
Discuss the Option for the Poor and Vulnerable: "A basic moral test is how our most vulnerable members are faring. In a society marred by deepening divisions between rich and poor, our tradition recalls the story of the Last Judgment (Mt 25:31-46) and instructs us to put the needs of the poor and vulnerable first" (taken from Seven Themes of Catholic Social Teaching http://www.usccb.org/beliefs-and-teachings/what-we-believe/catholic-social-teaching/seven-themes-of-catholic-social-teaching.cfm).

Resources (attachments):
Article on the negative effect of payday loans: http://www.loyno.edu/jsri/payday-loans-and-catholic-social-teaching-modern-form-usury

USCCB: "Economic Justice-Economy" http://www.usccb.org/issues-and-action/human-life-and-dignity/economic-justice-economy/index.cfm

Activities/Timeline:
Pre-Activity: Students should have prior knowledge of exponential functions and compound interest before beginning activity. If necessary, review this material.

Lesson Description: This lesson ties mathematical operations with the FAFSA college aid application.

Direct Instruction: See attached FAFSA word document.

Guided Instruction: While students are working, watch and make sure they are doing the math correctly.

Activity:
1. Pass out/download the FAFSA word document.
2. Review with students the basic steps from the word document.
3. Allow students the rest of the period to research their college statistics and possible FAFSA loan information.
4. At some future day, spend about 25-30 minutes of individual work while you check the mathematics in their work.

Formative Assessment (what to look for, how/when to look):
Mathematical component: observe the steps and students' final answers. Catholic identity: Ask students how this project will affect their college decisions. Students must discuss the long-term effects of loans in the context of both mathematics and Catholic Social teachings.

Summative Assessment:

Handout

FAFSA-College Loan Payment Project PRE-CALCULUS

PART I: Estimated Student Loans/Family Costs

A. Find how much your college tuition will be at the school you hope to attend. Go to http://nces.ed.gov/collegenavigator/:
    a. Locate the school of your choice and go to the "Tuition, Fees and Estimated Student Expenses" tab.
    b. Decide if you will live on or off campus and if you will be in- or out-of-state.
    c. Calculate the "Total Expenses" for your situation for each of the next four years.

B. Go to the "Net Price" tab and click on the link to "Visit this institution's net price calculator."
    a. Fill out all the information to estimate your government financial aid packet.
    b. Write down the all the financial information on the final page. This includes college cost, grants and scholarships, work-study, difference, and EFC (Expected Family Contribution).

*** If the link to the net price calculator does not work, the following is an alternative. Go to http://studentaid.ed.gov/fafsa/estimate and click on the "FAFSA4caster" link.

    c. Fill out all the information to estimate your government financial aid packet.
    d. Include the total cost of one year at the school you hope to attend.
    e. Write down the all the financial information on the final page. This includes college cost, grants and scholarships, work-study, difference and EFC (Expected Family Contribution).

PART II: Loan Rates and Payments

A. Go to http://www.simpletuition.com.
    a. Search for loans by entering the requested information, using Part I to calculate the amount of money you will need in loans.
    b. Fill out the college information and hit "Find Student Loan Rates"
    c. Choose a bank and copy down number of monthly payments and APR (annual percentage rate).

PART III: Calculations

1. Calculate the monthly payments on the loan of the size you will need.
    a. Take the 'difference' value and multiply times 4.
    b. Use the following formula to find your monthly payments.

First, you must define some variables to make the formula easier to set up:

- **P** = principal, the initial amount of the loan
- **I** = the annual interest rate (from 1 to 100 percent)
- **L** = length, the length (in years) of the loan, or at least the length over which the loan is amortized

The following assumes a typical conventional loan where the interest is compounded monthly. Two more variables make the calculations easier:

- **J** = monthly interest in decimal form = I / (12 x 100)
- **N** = number of months over which loan is amortized = L x 12

The monthly payment (**M**) formula is:

$$M = P \times \frac{J}{1 - (1+J)^{-N}}$$

2. Calculate the total cost of the loan if you do not make monthly payments and pay the whole loan after 20 years.
    a. Use compound interest compounded monthly.
    b. P = total loan for four years, r = APR, t = 20 years.

PART IV: Conclusion

1. Create a spreadsheet, using Microsoft Excel, with all the information on it.
2. Each "PART" is to have its own box (use borders around it)
3. Each box should have all rows and columns labeled (what does the row or column represent?)
4. The spreadsheet will be graded.

LAST – write a conclusion paragraph about what you have learned and how you will apply your research to your college decision.