WAMC Lab Template

Math Concept(s): Understanding Exponential Interest (APR)
Source / Text: Cengage Section 2-5 Compounded Interest Formula
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Attach the following documents:

- Lab Instructions
- Student Handout(s)
- Rubric and/or Assessment Tool

Short Description (Be sure to include where in your instruction this lab takes place):

- In this lab, students will explore the power of interest in the APR formula through practical examples. They will calculate and analyze the future value of credit card debt and stock market investment, create tables and graphs, and highlight the interest accrued over time. Through group discussions and a creative poster project, students will gain a deeper understanding of how principal, rate, and time affect financial growth and the importance of understanding exponential growth in both debt and investing.

Teacher Lab Plan:

Lab Title: Understanding Interest to Live Your Best Life! (APR Debt/Investments)

Day 1:

1. Introduction (10 minutes):
    - Explain the APR formula and exponential growth.
    - Discuss the lab's objectives and importance.
2. Part 1: Credit Card Debt Analysis (20 minutes):
    - Explain the calculation of future value using A = P (1 + r)^t.
    - Students calculate the future value of a $1,000 credit card debt with a 24.8% APR over 5 years.
    - Students create a table of yearly values.
3. Part 2: Stock Market Investment Analysis (20 minutes):
    - Explain the calculation of future value for investment using the same formula.
    - Students calculate the future value of a $10,000 stock market investment with a 7% APR over 10 years.
    - Students create a table of yearly values.
4. Part 3: Plotting the Data (10 minutes):
    - Briefly introduce the graphing task to be completed as homework or continued on Day 2.
    - Students start plotting the credit card debt and stock market investment data on separate graphs.

Day 2:

1. Complete Graphing the Data (10 minutes):
    - Students finalize their graphs, plotting both the credit card debt and stock market investment data.
    - Students use different colored pens to highlight the area under each curve, dividing it into 1-year pieces cut cutting and labeling the interest amount for each year.
2. Group Discussion (20 minutes):
    - Discuss how the initial amount (P), rate (R), and time (t) affect the function.
    - Analyze whether each year's interest is the same and why.
    - Discuss the importance of understanding time as an exponent in the APR formula.
3. Poster Creation (20 minutes):
    - Students work in groups to create a poster on an 11x17 piece of paper.
    - The poster should include explanations of the APR formula, highlighted interest areas, and advice on the importance of understanding time in financial contexts.
4. Presentation and Post-Lab Follow-Up (10 minutes):
    - Briefly present posters to the class. doing a gallery walk
    - Discuss real-world applications of the lab findings and explore career applications in finance, accounting, and economics.

Assessment Criteria:

- Accuracy of Calculations and Data Tables: Ensure all calculations are correct and data tables are complete.
- Quality and Clarity of Graphs and Highlighted Interest Areas: Graphs should be clear, accurate, and correctly highlight interest areas with appropriate labels.
- Participation in Group Discussion and Insights Shared: Active participation and thoughtful insights during discussions.
- Creativity and Informativeness of the Poster: The poster should be creative, informative, and effectively explain the APR formula and its importance.

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Lab Procedure: **STUDENT Handout**

Part 1: Credit Card Debt Analysis

1. **Calculate the Future Value of Credit Card Debt**:
    - Principal (P) = $1,000
    - Annual Percentage Rate (APR) = 24.8%
    - Time (t) = 5 years
    - Use the formula A = P (1 + r)^t where r is the APR (0.248) and t is the time in years.
2. **Create a Table**:
    - Yearly values for the amount owed using time as the independent variable.

Part 2: Stock Market Investment Analysis

1. **Calculate the Future Value of Stock Market Investment**:
    - Principal (P) = $10,000
    - Annual Growth Rate = 10%
    - Adjusted APR considering inflation = 7%
    - Time (t) = 10 years
    - Use the same formula as above
2. **Create a Table**:
    - Yearly values for the investment amount using time as the independent variable.

Part 3: Plotting the Data

1. **Graph the Data**:
    - Plot the credit card debt data on one graph.
    - Plot the stock market investment data on another graph.
2. **Highlight Interest**:
    - Use different colored pens to highlight the area under each curve, dividing it into 1-year pieces. Cut them into a 1 year piece.
    - Label each year and the interest amount for that year for both the credit card debt and the stock market investment,

Part 4: Group Discussion

1. **Discuss the APR Formula**:
    - How did the initial amount (P), rate (R), and time (t) affect the function?
    - Are all the pieces for each color the same? What does this mean for the interest for that year?
    - Considering time as the exponent in the equation, what must investors and borrowers understand about time?
2. **Create a Poster**:
    - Use an 11x17 piece of paper.
    - Include explanations of the APR formula.

- Provide specific advice on the importance of understanding the power of time in both debt and investing.

Rubric For Grading the Lab (Assessment): Student Handout

Criteria:	4 - Excellent	3 - Good	2 - Satisfactory	1 - Needs Improvement
Accuracy of Calculations and Data Tables	All calculations are accurate, and data tables are complete and correct.	Most calculations are accurate with minor errors; data tables are mostly correct.	Several errors in calculations; data tables are partially correct.	Many errors in calculations; data tables are incomplete or mostly incorrect.
Quality and Clarity of Graphs and Highlighted Interest Areas	Graphs are clear, accurate, and correctly highlight interest areas with appropriate labels.	Graphs are clear with minor inaccuracies; interest areas are highlighted and labeled adequately.	Graphs have several inaccuracies; interest areas are poorly highlighted or labeled.	Graphs are unclear or inaccurate; interest areas are not highlighted or labeled correctly.
Participation in Group Discussion and Insights Shared	Actively participates in discussions, providing thoughtful insights and contributing significantly.	Participates in discussions, offering relevant insights and contributing adequately.	Limited participation in discussions; offers few insights or contributions.	Does not participate in discussions; provides little to no insights or contributions.
Creativity and Informativeness of the Poster	Poster is highly creative, informative, and effectively explains the APR formula and its importance.	Poster is creative and informative, explaining the APR formula and its importance adequately.	Poster shows some creativity and information but lacks depth in explaining the APR formula.	Poster lacks creativity and informativeness; does not effectively explain the APR formula.

Prerequisite Skills: To successfully complete this lab, students should have the following prerequisite skills:

1. **Basic Algebra Skills**:
    - Understanding of variables and constants.
    - Ability to solve linear equations.
    - Familiarity with exponentiation.
2. **Understanding of Functions**:
    - Ability to interpret and manipulate mathematical functions.
    - Knowledge of function notation.
3. **Graphing Skills**:
    - Plotting points on a coordinate plane.
    - Understanding of the x-axis and y-axis.
    - Ability to read and create line graphs.
4. **Basic Financial Literacy**:
    - Understanding of basic financial terms such as principal, interest rate, and time.
    - Basic comprehension of how interest works, including simple vs. compound interest.
5. **Calculator Skills**:
    - Proficiency in using a scientific calculator for exponentiation and other necessary calculations.
6. **Group Work Skills**:
    - Ability to collaborate effectively with peers.
    - Communication skills for discussing and presenting findings.
7. **Basic Understanding of Exponential Growth**:
    - Knowledge of how exponential growth differs from linear growth.
    - Ability to identify real-world examples of exponential growth.
8. **Critical Thinking and Analysis**:
    - Skills to analyze and interpret data.
    - Ability to draw conclusions based on graphical and numerical data.

Lab Objective: Learn about the power of interest in the APR formula through practical examples. Create and analyze tables and graphs for credit card debt and stock market investment. Discuss the implications of principal, rate, and time on interest growth.

By the end of this lab, students will be able to:

1. **Calculate Future Values**:
    - Apply the formula A=P(1+r)tA = P (1 + r)^tA=P(1+r)t to calculate the future value of both a credit card debt and a stock market investment over specified time periods.
2. **Create and Analyze Tables**:

- Construct tables showing the yearly values of a $1,000 credit card debt at an APR of 24.8% over 5 years and a $10,000 stock market investment growing at an adjusted APR of 7% over 10 years.

3. **Graph Financial Data**:
   - Plot the data from the tables on two separate graphs, accurately representing the growth of debt and investment over time.
4. **Highlight and Interpret Interest**:
   - Highlight the area under each curve using different colored pens, dividing the area into 1-year segments, and labeling the interest accrued each year.
5. **Understand the APR Formula**:
   - Discuss how the principal amount (P), interest rate (R), and time (t) affect the growth of debt and investment.
   - Analyze whether the interest accrued each year is consistent and why.
6. **Comprehend the Impact of Time**:
   - Understand the exponential nature of the formula and the significant impact of time on the growth of both debt and investment.
7. **Communicate Financial Insights**:
   - Collaborate to create a poster that explains the APR formula and provides advice on the importance of understanding the power of time in financial contexts, targeting the broader student body.

Standards: *(Note SPECIFIC relationship to Science, Technology, and/or Engineering)*

Mathematics K–12 Learning Standards:

- HSF-LE.A Construct and compare linear, quadratic, and exponential models and solve problems

Standards for Mathematical Practice:

- MP4 Model with mathematics.
- MP5 Use appropriate tools strategically.
- MP6 Attend to precision.
- MP7 Look for and make use of structure.

K-12 Learning Standards-ELA (Reading, Writing, Speaking & Listening):

- WIDA- Standard 3 Language for Mathematics:
  English language learners communicate information, ideas and concepts necessary for academic success in the content area of mathematics.

K-12 Washington State Financial Literacy Standards

9.EI Investing:

Explain how investing may build wealth and help meet financial goals: 2. Compare the impact of delaying investment for retirement to beginning investing early.

Leadership/21st Century Skills:

21st Century Interdisciplinary themes (Check those that apply to the above activity.)

☐ Global Awareness ☐ Financial/Economic/Business/Entrepreneurial Literacy ☐ Civic Literacy
☐ Health/Safety Literacy ☐ Environmental Literacy

21st Century Skills (Check those that students will demonstrate in the above activity.)

LEARNING AND INNOVATION
Creativity and Innovation
☐ Think Creatively
☐ Work Creatively with Others
☐ Implement Innovations
Critical Thinking and Problem Solving

INFORMATION, MEDIA & TECHNOLOGY SKILLS
Information Literacy
☐ Access and Evaluate Information
X Use and manage Information

LIFE & CAREER SKILLS
Flexibility and Adaptability
☐ Adapt to Change
☐ Be Flexible
Initiative and Self-Direction
☐ Manage Goals and Time
☐ Work Independently

Productivity and Accountability
☐ Manage Projects
☐ Produce Results
Leadership and Responsibility

X Reason Effectively X Use Systems Thinking ☐ Make Judgments and Decisions X Solve Problems Communication and Collaboration X Communicate Clearly ☐ Collaborate with Others	Media Literacy ☐ Analyze Media ☐ Create Media Products Information, Communications and Technology (ICT Literacy) ☐ Apply Technology Effectively	X Be Self-Directed Learners Social and Cross-Cultural ☐ Interact Effectively with Others ☐ Work Effectively in Diverse Teams	☐ Guide and Lead Others ☐ Be Responsible to Others

Teacher Preparation: (What materials and set-up are required for this lab?)

Materials:

- Calculator
- Graph paper
- Ruler
- Scissors
- Markers or
- Colored pencils
- 11x17 poster paper

Set-Up Required:

- Groups need Materials

Lab Organization Strategies:

Leadership:

How These Roles Promote 21st-Century Skills:

- **Project Leader:** Enhances leadership by guiding the team and managing the project. Develops collaboration and communication skills by ensuring effective teamwork and resolving conflicts. Builds time management and problem-solving abilities through planning and addressing project challenges.
- **Data Specialist:** Fosters analytical thinking and data literacy by collecting and analyzing data. Improves attention to detail and critical thinking through verifying data accuracy and performing precise calculations. Strengthens mathematical proficiency with advanced data analysis. Enhances research skills and information literacy by conducting thorough background research and providing context for the data.
- **Visualization Expert:** Develops technical proficiency with graphing tools and software. Encourages creativity and design thinking through the creation of visually appealing graphs. Enhances visual communication and data visualization skills by effectively representing complex data.
- **Documentation and Presentation Coordinator:** Builds strong written and oral communication skills by documenting the project and presenting the findings. Enhances organization and documentation abilities through meticulous record-keeping. Develops presentation skills and teamwork by coordinating the final presentation and ensuring balanced participation.

Cooperative Learning: Groups of 3 to 4 Students

1. **Project Leader**
    - **Responsibilities:** Oversees the entire project, ensures that tasks are completed on time, coordinates meetings, and facilitates communication among group members. Manages the project timeline and resolves conflicts.
    - **21st Century Skills Developed:** Leadership, collaboration, time management, communication, problem-solving.
2. **Data Specialist**
    - **Responsibilities:** Collects, organizes, and analyzes the data required for the project. Performs calculations to analyze the exponential APR and verifies data accuracy. Assists in breaking the graph into interest pieces by years.
    - **21st Century Skills Developed:** Analytical thinking, data literacy, attention to detail, critical thinking, mathematical proficiency.
3. **Visualization Expert**
    - **Responsibilities:** Creates the graphical representation of the data, ensuring the graph is accurate, clear, and visually engaging. Responsible for dividing the graph into interest pieces by years and using appropriate graphing tools.
    - **21st Century Skills Developed:** Technical proficiency, creativity, visual communication, data visualization, design thinking.
4. **Documentation and Presentation Coordinator**
    - **Responsibilities:** Documents the project process, writes the report, and prepares the final presentation. Ensures that the methodology, analysis, and results are clearly communicated. Coordinates the final presentation, making sure each group member contributes.
    - **21st Century Skills Developed:** Written and oral communication, organization, documentation, presentation skills, teamwork.

Expectations:
By the end of this lab, students should have a deeper understanding of the power of interest and the significant impact of time on financial growth, both positively and negatively.

Timeline:

- **Day 1**: Introduction to APR and Exponential Growth. Begin calculations and table creation. Complete tables and graphs. Highlight interest areas.
- **Day 2**: Group discussion and poster creation. Presentation of posters and post-lab follow-up.

Post Lab Follow-Up/Conclusions:

Real World Application: Discuss how the learning from this lab applies to real-world financial decisions. Consider scenarios involving credit card debt, loans, and investments.

Career Applications: Explore careers in finance, accounting, and economics where understanding APR and exponential growth is crucial.

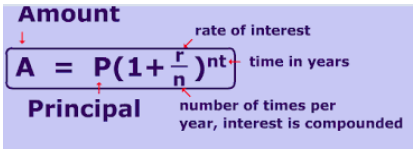
Optional or Extension Activities:

1. Comparative Analysis of Different APRs and Investment Rates

- **Task**: Students will research and compare different types of credit card APRs and investment rates from various financial institutions.
- **Activity**:
  - Collect data on at least five different credit cards with varying APRs.
  - Collect data on at least five different investment opportunities with varying annual growth rates.
  - Calculate the future values for a given principal over a set period (e.g., 5 years for credit cards, 10 years for investments).
  - Create comparative tables and graphs for each scenario.
- **Outcome**: Students will present their findings, highlighting the impact of different rates on debt and investment growth.

2. Monthly Compounding vs. Annual Compounding

- **Task**: Analyze the effects of monthly compounding versus annual compounding on both credit card debt and stock market investments.
- **Activity**:



  - Use the formula where n is the number of compounding periods per year.
  - Calculate the future values for both monthly and annual compounding scenarios.
  - Create tables and graphs to compare the two compounding methods.
- **Outcome**: Students will write a report discussing the differences and implications of monthly versus annual compounding.

3. Impact of Varying Inflation Rates on Investment Growth

- **Task**: Investigate how varying inflation rates affect the real return on investments.
- **Activity**:
  - Research historical inflation rates over the past 20 years.
  - Adjust the annual growth rate of a $10,000 investment to reflect different inflation rates.
  - Calculate the real return on investment for each scenario.
  - Create tables and graphs to visualize the impact of inflation on investment growth.

- **Outcome**: Students will present their findings, discussing how inflation erodes investment returns and strategies to mitigate this impact.

4. Scenario Analysis: Impact of Additional Contributions and Payments

- **Task**: Explore the impact of making regular additional contributions to investments and regular payments towards credit card debt.
- **Activity**:
    - Assume an additional $100 is invested monthly in the stock market.
    - Assume an additional $50 is paid monthly towards the credit card debt.
    - Calculate the future values for both scenarios over 5 and 10 years, respectively.
    - Create tables and graphs to show the impact of these additional contributions and payments.
- **Outcome**: Students will analyze and present how regular contributions and payments can significantly alter the financial outcomes, emphasizing the power of consistent financial habits.

5. Case Study Analysis

- **Task**: Conduct a detailed case study analysis of a real-world financial scenario involving debt and investment.
- **Activity**:
    - Choose a real-world case study (e.g., a family's journey to pay off debt and start investing).
    - Analyze their financial decisions, including APR on debt and investment growth rates.
    - Calculate the outcomes based on their strategies and compare with alternative strategies.
- **Outcome**: Students will prepare a comprehensive case study report, offering insights and recommendations based on their analysis.

Assessment: *Rubic attached in description and is the backside of the handout

- Accuracy of calculations and data tables.
- Quality and clarity of the graphs and highlighted interest areas.
- Participation in group discussion and insights shared.
- Creativity and informativeness of the poster.

Washington Applied Math Council

https://wa-appliedmath.org/