Compound, continuously compounded, and simple interest formulas are compared using Matlab calculations and graphing features. This module enables students to better visualize the different outcomes and introduces them to exponential functions. In addition, students also strengthen their Matlab coding skills by allowing them to change parameters to find the correct answers. Matlab is an essential tool that will be used to simulate research problems and to explore classroom concepts.

This module contains a lesson plan and a worksheet.
# Science Lesson Plan

**Teacher:**

**Period:**

**Date(s):** Lesson # 2

**Class:** AP Precalc

## SETTING THE STAGE

<table>
<thead>
<tr>
<th>Essential Question</th>
<th>What kind of information can we obtain from exponential functions?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content Objective(s) (Student-friendly)</td>
<td>To use Matlab to compute, graph exponential functions and to answer questions about the function by changing parameters in a Matlab program.</td>
</tr>
<tr>
<td>Connection to previous or future lessons</td>
<td>Material in this lesson plan will be applied to build the next computing lesson on graphing and writing functions using Matlab. Students will learn to change small sections of the program to help improve programming skills.</td>
</tr>
<tr>
<td>Critical Thinking Questions</td>
<td>How can we use a graph to make predictions?</td>
</tr>
<tr>
<td>Key Vocabulary</td>
<td>Variables</td>
</tr>
<tr>
<td></td>
<td>Dimensions</td>
</tr>
<tr>
<td></td>
<td>Array</td>
</tr>
<tr>
<td></td>
<td>Program</td>
</tr>
<tr>
<td>Materials Needed/Safety</td>
<td>Computers with Matlab software</td>
</tr>
<tr>
<td></td>
<td>Matlab reference guide.</td>
</tr>
<tr>
<td></td>
<td>Matlab code</td>
</tr>
</tbody>
</table>

## ACTIVE INSTRUCTION

- **Launch (Engage)**
  
  Teacher makes a connection to prior work; using exponentials to find information about interest problems.

- **Investigation (Explore)**
  
  Students are given a demonstration of finding information about a compound interest problem using Matlab. Then students are given a sheet with several questions and they are asked to find the answers. The questions require students to change the program but also to have an understanding of exponentials. Students will have reference guides to help them along. Changing the code will help the students understand the meaning of the code and why each line is written.

*This template is available in electronic form.*
**Science Lesson Plan**

**Teacher:**

<table>
<thead>
<tr>
<th>TIME FOR REFLECTION</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Summarization (Explain &amp; Extend)</td>
<td>Time will be set aside to share any challenges encountered during the activity and to discuss the benefits of using software to find answers to Mathematical problems. When is software useful?</td>
</tr>
<tr>
<td>• Assessment (Evaluate)</td>
<td>Written notes in their journals will be reviewed.</td>
</tr>
<tr>
<td>• Homework</td>
<td></td>
</tr>
</tbody>
</table>
Compound Interest Formula
\[ A = P \times (1 + \frac{r}{n})^{nt} \]
Continuous Compounding
\[ A = P \times e^{rt} \]
Simple Interest
\[ A = P + P \times r \times t \]

Where:
- \( A \) = Account balance
- \( P \) = Principal (amount you invest)
- \( r \) = rate in decimal ex: 2% = 0.02
- \( n \) = number of compounding per year (daily \( n = 365 \); monthly \( n = 12 \); quarterly \( n = 4 \); semi-annually \( n = 2 \), annually \( n = 1 \))
- \( t \) = time in years ex: 6 months = 0.5

1. Suppose Julykie has $1,000 that she invests in an account that pays 3.5% interest compounded quarterly. How much money does Julykie have at the end of 5 years?

2. Gerard plans to put his graduation money into an account and leave it there for 4 years while he goes to college. He receives $750 in graduation money that he puts it into an account that earns 4.25% interest compounded semi-annually. How much will be in Gerard's account at the end of four years?

3. How much money would you have in 5 years if today you were going to invest $500 in an account that earns 3.75% interest and is compounded annually?
   How about after 10 years? _________ 20 years? _________ 40 years? _________

4. How much money would you have in 5 years if today you invested $500 in a continuously compounded account at a rate of 3.75%?
   How about after 10 years? _________ 20 years? _________ 40 years? _________

5. How much money would you have in 5 years if today you invested $1500 in a savings account at a rate of 3.75%?
   How about after 10 years? _________ 20 years? _________ 40 years? _________

6. Estimate how long will it take $4000 to triple if it is invested at 5% compounded continuously?
   Explain your answer: ___________________________________________
7. Estimate: LHS Bank is offering to double your money! They say that if you invest with them at 6% interest compounded quarterly they will double your money. If you invest $1500 in the account, how long will it take to double your money.

Explain your answer:

```matlab
clear all, close all;
P=4000;     %principal amount (amount you invest)
r=0.05;     %rate in decimal ex: 2%=0.02
n=1;       %number of compounding per year
%t=10;       %time in years ex: 6months =0.5 Use this format when finding actual value

q=0.06/4;  %6% interest compounded quarterly
ht=0:1:20;  % Time begins at 0, ends at 10 years in 1 year increments. Use for PLOTTING
format bank

%Compound Interest Formula
A= P*(1 + (r/n)).^(n*t)

%Continuously Compound Formula
A1=P*exp(r*t)

%simple interest Formula
A2=P+P*r*t

plot(t,A,'g',t,A1,'r',t,A2,'b') %Graphs each function with colors green,red,blue
xlabel('Time in years') %Labels x-axis
ylabel('Account Balance') %Labels y-axis
title('Graphing Compound, Continuously Compounded and Simple Interest Examples')

grid;
```