Financial Literacy with Mr. 401(k)
Spring Term 2026
May 7, 2026

Time and Money

Class 23: The Power of Time - Compound Interest with Lump Sum Formulas

Practical Application 🧠

Jane lends $100 to John for exactly one month. At the end of one month, John repays Jane exactly $100.

Who benefited most from this trade? Why?

Practical Application

Jane lends $100 to John for exactly one month. At the end of one month, John repays Jane exactly $100.

What if John paid Jane back $105 instead of $100? Does that change things?

What Is Time Value of Money?

Think of it like money now beats money later.

JARGON ALERT

Time Value of Money

Money today is **always** worth more than the same amount of money in the future.* Why? Because of 2 forces: **Inflation** and **Interest Rate**.

Force 1: Inflation

When prices go **UP,** your money buys **LESS.**

A $100 bill in a drawer for 10 years still says "$100" on the front of it but it will buy fewer games and snacks. **Inflation costs you purchasing power.**

Example: Your favorite snack costs $5 today. By the time you're an adult, it may cost $10.

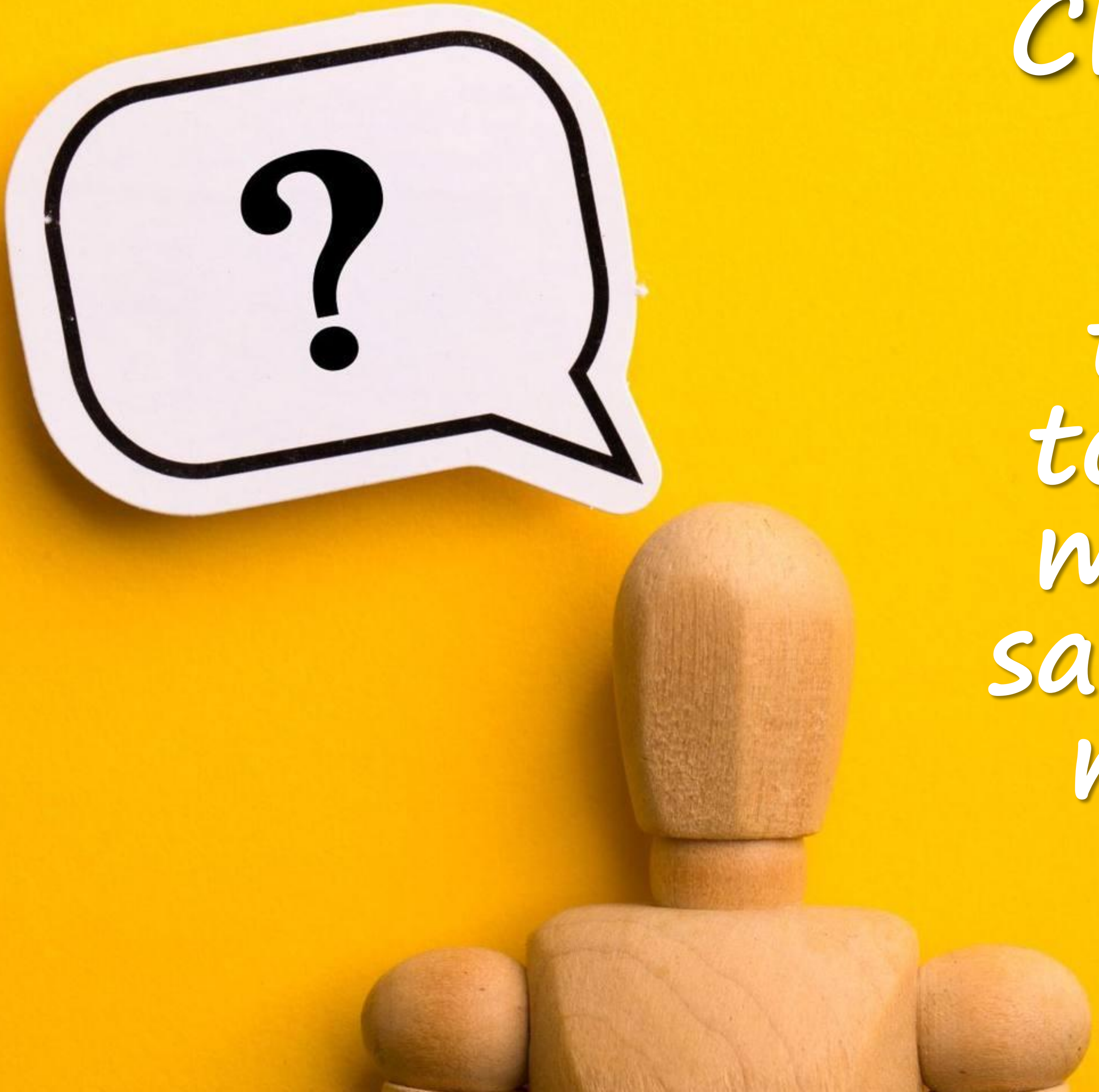
Force 2: Interest Rates

When you **INVEST**, your money can **GROW**.

$100 saved or invested can earn interest. **Having money right now** gives it a chance to grow, whereas a promise of money later can't.

Example: $1,000 in high yield savings may grow 3% to $1,030 and keeps growing each year thereafter.

* Presuming an inflating monetary unit of account.



Class Discussion

Why do you think money today is worth more than the same amount of money in the future?

Recap: Simple Interest Formula

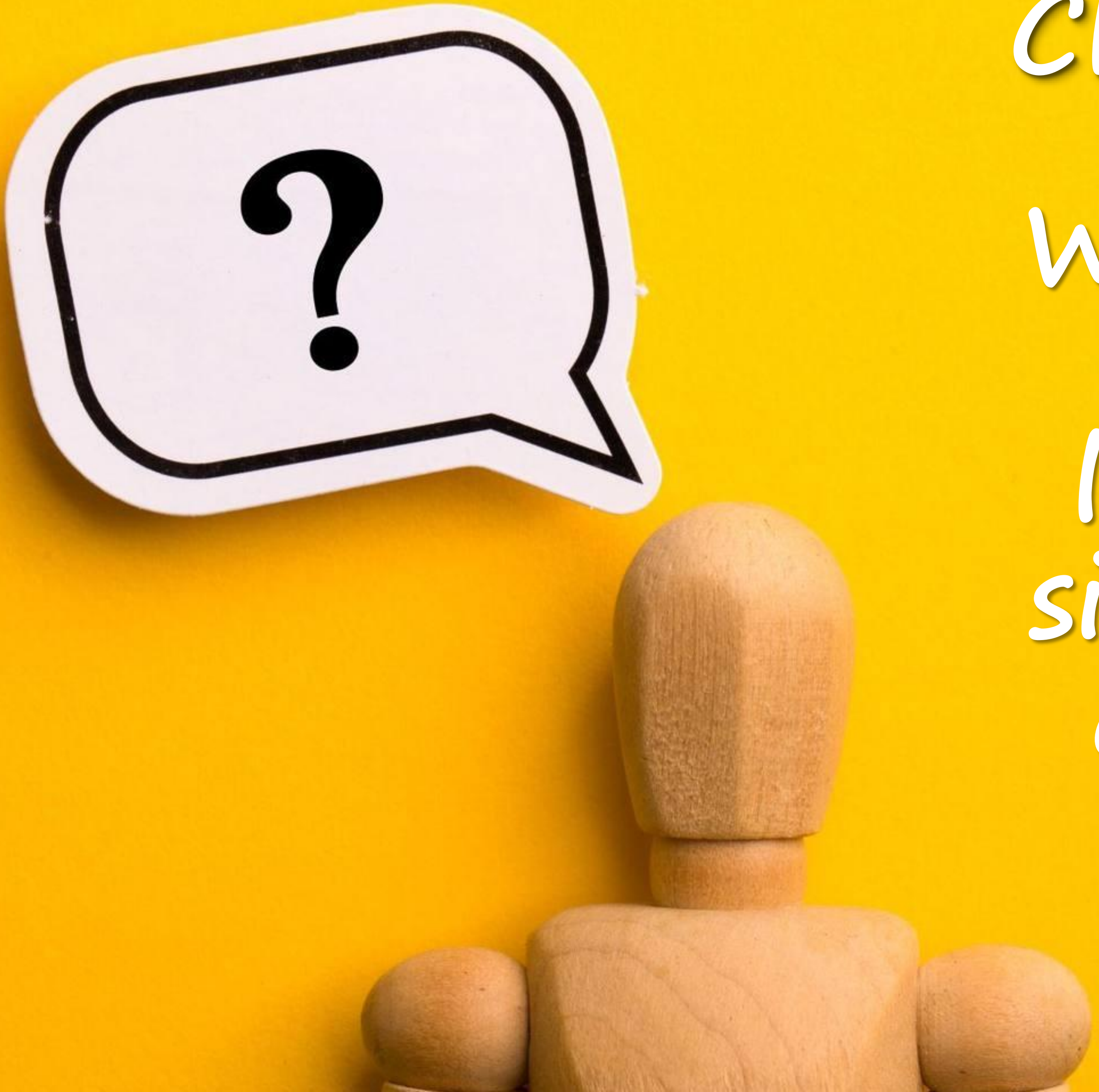
$$Interest = Principal \times Rate \times Time\ in\ Years$$

$$I = P \times r \times t$$

Worked Example: Jane lends John **$100** at **5%** for **2 years**.

$$Interest = \$100 \times 5\% \times 2 = \$10$$

After 2 years, John pays back $100 in principal + $10 in interest = $110 total



Class Discussion

What might be some of the limitations of simple interest calculations?

What Simple Interest Misses

JARGON ALERT

1 Only Earns on the Original Amount

Simple interest only grows on the money you started with and never on the interest you have already earned.

If you invest $100, simple interest only pays interest on that original $100, and not on the interest you already earned.

2 Every Year Starts Over

Simple interest treats each year like Year One. It does not build on past interest.

It is like pressing the reset button each year, instead of building on what you already earned.

SEE THE DIFFERENCE.

$100, earning 10% interest, after 30 years:

Simple Interest	Compound Interest
$400	$1,745

What Is Compound Interest?

Think of it like interest on interest

JARGON ALERT

Compound Interest

Interest that earns its own interest. Each period money grows on the original principal plus all the interest already added to it.

Principal

The starting amount of money you save, invest, or borrow, before any interest is added.

Interest Rate

The percentage your money grows each period. A 7% rate means your balance grows by 7% every year.

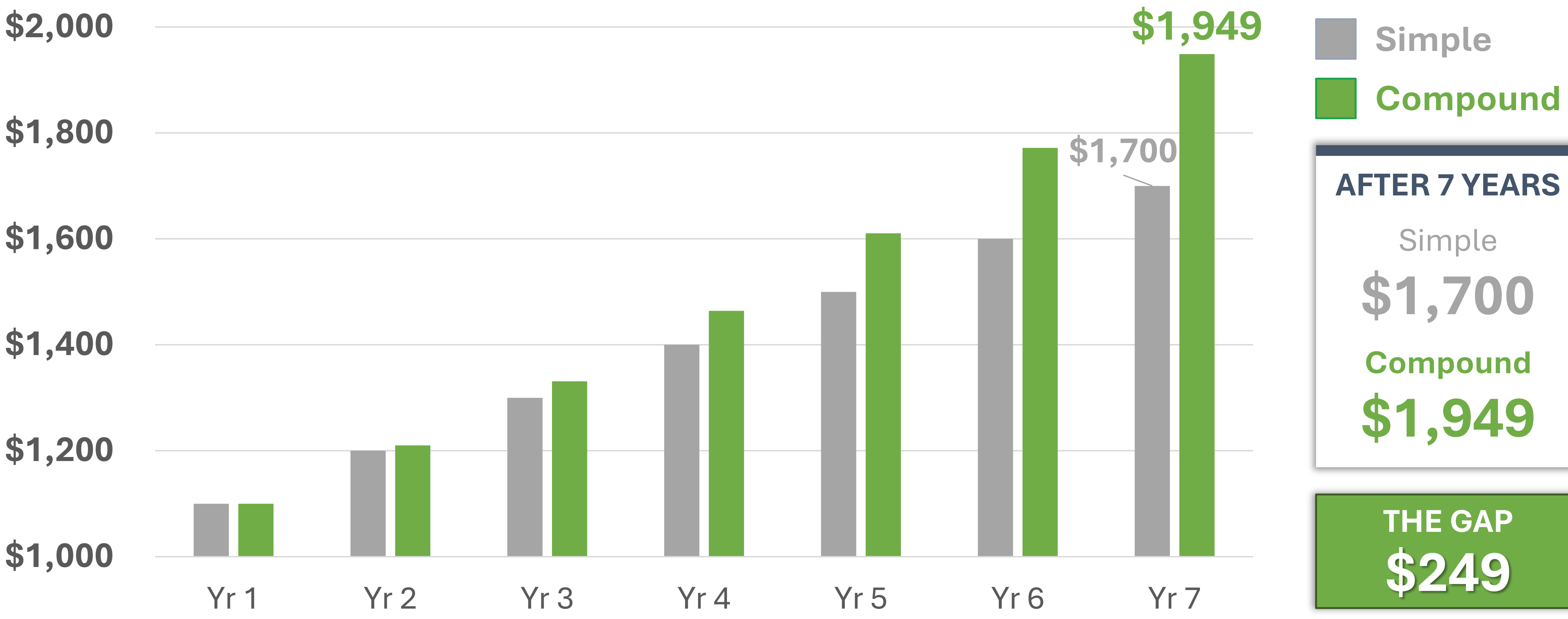
Snowball Effect

Past interest counts, and earns more interest, creating a snowball effect where balances grow faster over time.

💡 Contrast with simple interest, which only earns on the original principal.

Watch the Gap Widen

*$1,000 at 10% interest: **Simple** vs. **Compound**, year by year*



AFTER 7 YEARS

Simple

$1,700

Compound

$1,949

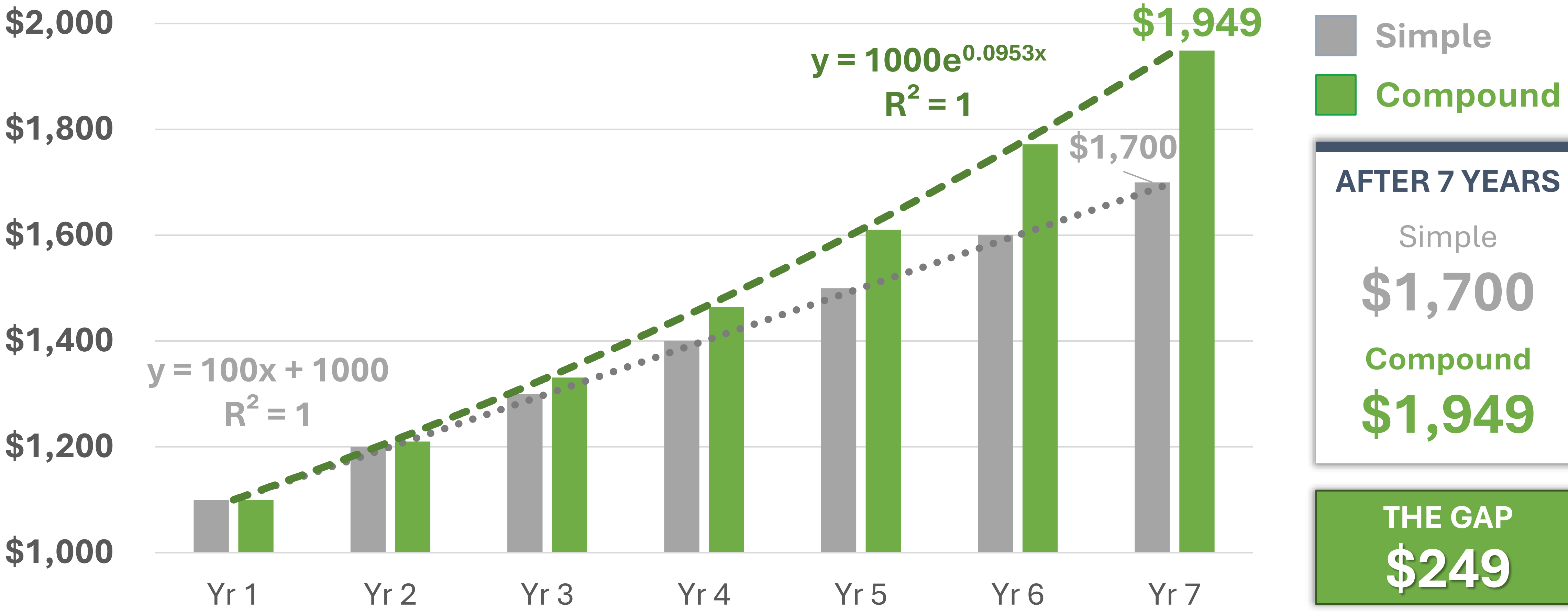
THE GAP

$249

💡 **That extra $249 came from compound interest.** The gap grows faster every year.

Watch the Gap Widen

$1,000 at 10% interest: ***Simple*** *vs.* ***Compound****, year by year*



AFTER 7 YEARS

Simple

$1,700

Compound

$1,949

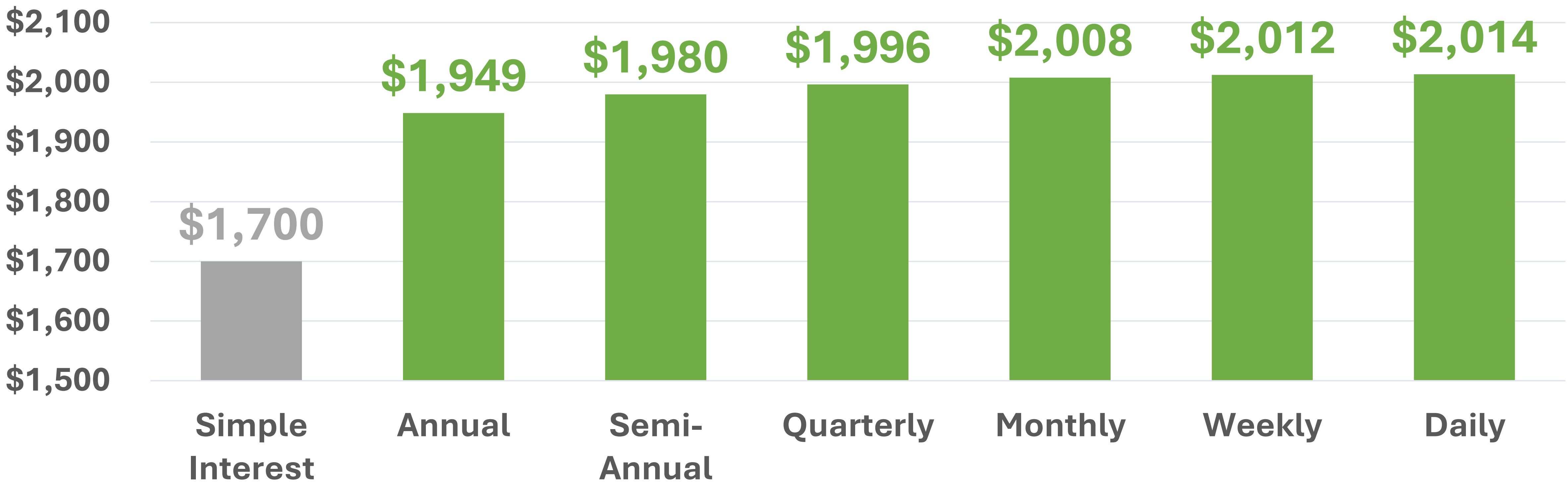
THE GAP

$249

💡 **That extra $249 came from compound interest.** The gap grows faster every year.

Compounding More Often Helps, But Gains Shrink

1,000 at 10% for 7 years, compounded at different frequencies



ADDED OVER PREVIOUS:	—	+$249	+$31	+$16	+$12	+$4	+$2

💡 **The biggest jump is from simple → annual.** After that, each increased frequency adds less and less. Notice that *compounding daily barely beats compounding monthly.*

The Rule of 72

A quick way to estimate how fast your money doubles

$$\text{Years to Double Your Money} \approx \frac{72}{\text{Interest Rate (\%)}}$$

High Yield Savings Account

At 3.5%: **~20.6 years**

Balanced Portfolio

At 7.2%: **~10.0 years**

S&P 500 Index

At 10%: **~7.2 years**

💡 No calculator needed! Just divide 72 by the interest rate to estimate your doubling time.

72 is the most powerful number in finance! Past performance is not a guarantee of future results.

Practical Application

John saved $1,000 from summer yard care work. John deposits the $1,000 into a high yield savings account. The high yield savings account pays 4.5% annual interest, compounded monthly. What would the value of this be after 3 years?

How Much Will Your Money Grow?

Compound Growth Formula: Future Value of a Lump Sum

$$FV = PV(1 + r/n)^{nt}$$

WHAT EACH VARIABLE MEANS

- FV — **Future Value** = Ending amount
- PV — **Present Value** = Your starting amount
- r — **Interest Rate** = Annual rate earned
- n — **Compounding Frequency** = Times per year
- t — **Time** = Years invested

WHAT "n" LOOKS LIKE IN PRACTICE

More frequent compounding = faster growth.

- $n = 1$ → Once a year *(annually)*
- $n = 2$ → Twice a year *(semi-annually)*
- $n = 4$ → Four times a year *(quarterly)*
- $n = 12$ → Every month *(monthly)*
- $n = 52$ → Every week *(weekly)*
- $n = 365$ → Every day *(daily)*

💡 Plug in your numbers, follow the order of operations, and the formula gives your future value.

Practical Application

John saved $1,000 from summer yard care work. John deposits the $1,000 into a high yield savings account. The high yield savings account pays 4.5% annual interest, compounded monthly. What would the value of this be after 3 years?

$$FV = PV(1 + r/n)^{nt}$$

Practical Application

John saved $1,000 from summer yard care work. John deposits the $1,000 into a high yield savings account. The high yield savings account pays 4.5% annual interest, compounded monthly. What would the value of this be after 3 years?

$$FV = PV(1 + r/n)^{nt}$$

$$FV = 1{,}000(1 + 0.045/12)^{12 \cdot 3}$$

Practical Application

John saved $1,000 from summer yard care work. John deposits the $1,000 into a high yield savings account. The high yield savings account pays 4.5% annual interest, compounded monthly. What would the value of this be after 3 years?

$$FV = PV(1 + r/n)^{nt}$$

$$FV = 1{,}000(1 + 0.045/12)^{12\cdot 3}$$

$$\boldsymbol{FV = \$1,144.25}$$

Practical Application

Jane wants to purchase a new bicycle in 4 years. Jane expects the bicycle will cost about $800. Jane wants to invest money today toward the purchase. If Jane expects to earn 10% compounded annually on a stock portfolio, how much does Jane need to invest today?

How Much Do You Need Today?

Compound Growth Formula: Present Value of a Lump Sum

$$PV = FV/(1 + r/n)^{nt}$$

WHAT EACH VARIABLE MEANS

- PV **Present Value** = Amount you need today
- FV **Future Value** = Goal amount
- r **Interest Rate** = Annual rate earned
- n **Compounding Frequency** = Times per year
- t **Time** = Years to goal

WHAT "n" LOOKS LIKE IN PRACTICE

More frequent compounding = less you need to start with.

- $n = 1$ → Once a year *(annually)*
- $n = 2$ → Twice a year *(semi-annually)*
- $n = 4$ → Four times a year *(quarterly)*
- $n = 12$ → Every month *(monthly)*
- $n = 52$ → Every week *(weekly)*
- $n = 365$ → Every day *(daily)*

💡 Start with the future goal, divide by the growth factor, and the formula tells you what to set aside today.

Practical Application

Jane wants to purchase a new bicycle in 4 years. Jane expects the bicycle will cost about $800. Jane wants to invest money today toward the purchase. If Jane expects to earn 10% compounded annually on a stock portfolio, how much does Jane need to invest today?

$$PV = FV/(1 + r/n)^{nt}$$

Practical Application

Jane wants to purchase a new bicycle in 4 years. Jane expects the bicycle will cost about $800. Jane wants to invest money today toward the purchase. If Jane expects to earn 10% compounded annually on a stock portfolio, how much does Jane need to invest today?

$$PV = FV/(1 + r/n)^{nt}$$

$$PV = 800/(1 + 0.10/1)^{1 \cdot 4}$$

Practical Application

Jane wants to purchase a new bicycle in 4 years. Jane expects the bicycle will cost about $800. Jane wants to invest money today toward the purchase. If Jane expects to earn 10% compounded annually on a stock portfolio, how much does Jane need to invest today?

$$PV = FV/(1 + r/n)^{nt}$$

$$PV = 800/(1 + 0.10/1)^{1 \cdot 4}$$

$$\boldsymbol{PV = \$546.41}$$

What About Rate and Time?

The same formula family can also solve for r and t. Excel can do the work!

So far, we've solved for **FV** and **PV**. The same **FV** = **PV**$(1 + r/n)^{nt}$ equation can be rearranged with algebra and logarithms to solve for **r** or **t**. [Learn it by hand]

SOLVE for r: WHAT RATE DO I NEED?

The question: "I have $**PV** today and I want $**FV** in ***t*** years. What rate ***r*** do I need?"

Use it to: figure out if a savings account, bond, or index fund can realistically get you to your goal. A high-yield savings account might pay ~3%; the stock market has averaged ~10% long-term.

Excel: =RATE(nper, pmt, pv, [fv])

SOLVE FOR t: HOW LONG WILL IT TAKE?

The question: "I have $PV today at rate *r* . How long until it reaches $FV?"

Use it to: check if your timeline is realistic. Want to turn $1,000 into $10,000 at 7%? The math says ~34 years. Want to do it in 10 years? You'll need closer to 26%.

Excel: =NPER(rate, pmt, pv, [fv])

The same Time Value of Money relationship solves **four kinds of money questions**.
Excel (or a financial calculator) can handle the algebra and logs.

What do Time Value of Money Formulas Solve?

Four kinds of money questions, one family of formulas

JARGON ALERT

FV

Future Value

How much the money you have today can grow if you save or invest it.

KEY QUESTION
How much will your money grow?

PV

Present Value

How much you need today to reach a certain amount in the future.

KEY QUESTION
How much do you need today?

r

Interest Rate

How fast your money will grow — the rate of return you earn.

KEY QUESTION
What rate do I need to reach my goal?

t

Time

How long it will take to reach a specific savings or investment goal.

KEY QUESTION
How long before I save enough?

Money Mavericks

Objective: Work within your Money Mavericks Workgroups to solve each problem on the following Practical Applications Slide.

Practical Application

1. Jane invested **$1,000** for **1 year** at a **10% annual interest** rate compounded **annually.** How much did Jane have after 1 year?
2. John invested $1,000 for 1 year at a 10% interest rate compounded **monthly**. How much did John have after 1 year?
3. Jane invested $1,000 for **10 years** at a 10% interest rate compounded monthly. How much did Jane have after 10 years?
4. John invested $1,000 for 10 years at a 10% interest rate compounded **daily**. How much did John have after 10 years?
5. Jane invested **$5,000** for **25 years** at a 10% interest rate compounded **monthly**. How much did Jane have after 25 years?
6. John invested **$100,000** for **30 years** at a 10% interest rate compounded **monthly**. How much did John have after 30 years?

$$Formula\colon\ FV = PV(1 + r/n)^{nt}$$

Practical Application Answers

Problems 1 – 3 | Replicate in Microsoft Excel: =FV(rate,nper,pmt,[pv],[type])

#	Problem	Excel Function	Answer
1	Jane invested $1,000 for 1 year at a 10% annual interest rate compounded annually. How much did Jane have after 1 year?	=FV(10%/1,1*1,0,-1000,0)	$1,100
2	John invested $1,000 for 1 year at a 10% interest rate compounded monthly. How much did John have after 1 year?	=FV(10%/12,1*12,0,-1000,0)	$1,105
3	Jane invested $1,000 for 10 years at a 10% interest rate compounded monthly. How much did Jane have after 10 years?	=FV(10%/12,10*12,0,-1000,0)	$2,707

$$Formula\colon\ \boldsymbol{FV} = \boldsymbol{PV}(\mathbf{1} + \boldsymbol{r}/\boldsymbol{n})^{\boldsymbol{nt}}$$

Practical Application Answers

Problems 4 – 6 | Replicate in Microsoft Excel: =FV(rate,nper,pmt,[pv],[type])

#	Problem	Excel Function	Answer
4	John invested $1,000 for 10 years at a 10% interest rate compounded daily. How much did John have after 10 years?	=FV(10%/365,10*365,0,-1000,0)	$2,718
5	Jane invested $5,000 for 25 years at a 10% interest rate compounded monthly. How much did Jane have after 25 years?	=FV(10%/12,25*12,0,-5000,0)	$60,285
6	John invested $100,000 for 30 years at a 10% interest rate compounded monthly. How much did John have after 30 years?	=FV(10%/12,30*12,0,-100000,0)	$1,983,740

💡 Problem #6: $100,000 grows to nearly **$2 million** in 30 years at 10% compounded monthly. That's the power of time + compound interest!

Don’t Believe It? See It Year-by-Year

$100,000 at 10% interest: ***Simple*** *vs.* ***Compound****, year by year*

AFTER 30 YEARS

Simple

$0.400M

Compound

$1.983M

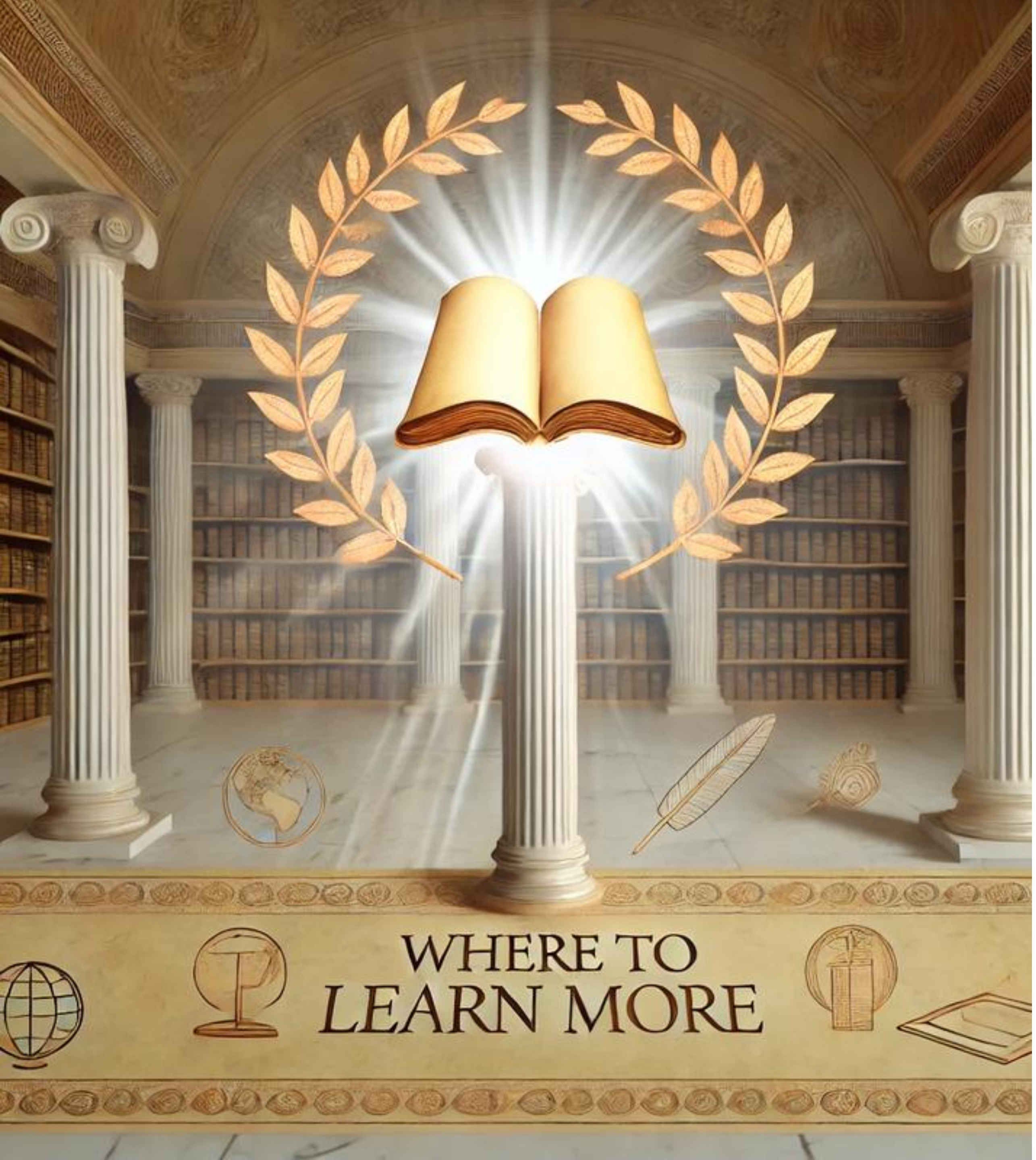
THE GAP

$1.583M

💡 **That extra $1,583,740 came from compound interest.** I told you earlier the gap grows faster every year!

Three Key Takeaways

1. Money today is worth more than the same amount of money in the future because of inflation and interest rates.
2. Simple interest considers only interest on the principal amount whereas compound interest calculates the interest on interest.
3. One of the most important formulas in finance is $FV = PV(1 + r/n)^{nt}$



Where to Learn More

- Time Value of Money Explained with Formula and Examples by Jason Fernado via Investopedia
- Understanding the Time Value of Money by Shauna Carther Heyford via Investopedia
- Video: Time Value of Money, by Khan Academy

What Rate Do I Need? How Long Will it Take?

Compound Growth Formula: Solving for Interest Rate & Time

$$r = n\left[\left(\frac{FV}{PV}\right)^{1/(nt)} - 1\right]$$

$$t = \frac{\ln(FV/PV)}{n\ln(1 + r/n)}$$

WHAT EACH VARIABLE MEANS

- r **Interest Rate** = Annual rate needed
- FV **Future Value** = Goal amount
- PV **Present Value** = Your starting amount
- n **Compounding Frequency** = Times per year
- t **Time** = Years to goal

This tells you the annual return your investment needs to hit your goal on time.

WHAT EACH VARIABLE MEANS

- t **Time** = Years it will take
- FV **Future Value** = Your goal amount
- PV **Present Value** = Your starting amount
- r **Interest Rate** = Annual rate earned
- n **Compounding Frequency** = Times per year

Use LN on your calculator (or =LN in Excel) to solve for time.

@PETROS_USA

https://linkedin.com/in/petrosk

Learn it. Earn it. Own it. Grow it.

Teaching young people how money really works

Financial Literacy with

Mr. 401(k)

https://petros.us/about-finlit