Financial Literacy with Mr. 401(k)
Spring Term 2026
May 11, 2026

Time and Money

Class 24: The Power of Time - Annuity Basics

Monday Money Matter$

New college graduates overestimate starting salaries by nearly $24,000, report finds. College graduates in 2026 expect to earn about $80,000 one year after graduation, but the average starting salary is closer to $56,000. This gap shows why it is important to research real salaries before making big money decisions, like choosing a college, major, or career path. The job market is challenging because some companies are hiring slowly and using AI for some entry-level work. Still, there is good news: starting salaries are rising in many fields, and employers expect to hire more new graduates than last year. For students, the lesson is to dream big, but plan with realistic numbers.

Source: CNBC; https://www.cnbc.com/2026/05/04/college-grads-overestimate-starting-salaries.html; Reference Date: May 4, 2026

Practical Application 🤔

Jane earns a $25 weekly allowance for completing her chores and homework.

Paying her every Friday is a hassle for Jane’s parents, so they propose a new deal: **$100 at the end of every 4 weeks** instead of $25 at the end of each week.

The total amount remains the same: $25 × 4 = $100.

Should Jane accept her parents' offer?

💡 Hint: Think about more than just the totals.

Quick Recap From Thursday

Time Value of Money: three ideas we'll build on today

Time Value of Money: Money today is always worth more than the same amount of money in the future.

1 Inflation

Prices generally rise over time, so tomorrow's dollars buy less. **Money in hand today** holds its purchasing power better than money promised later.

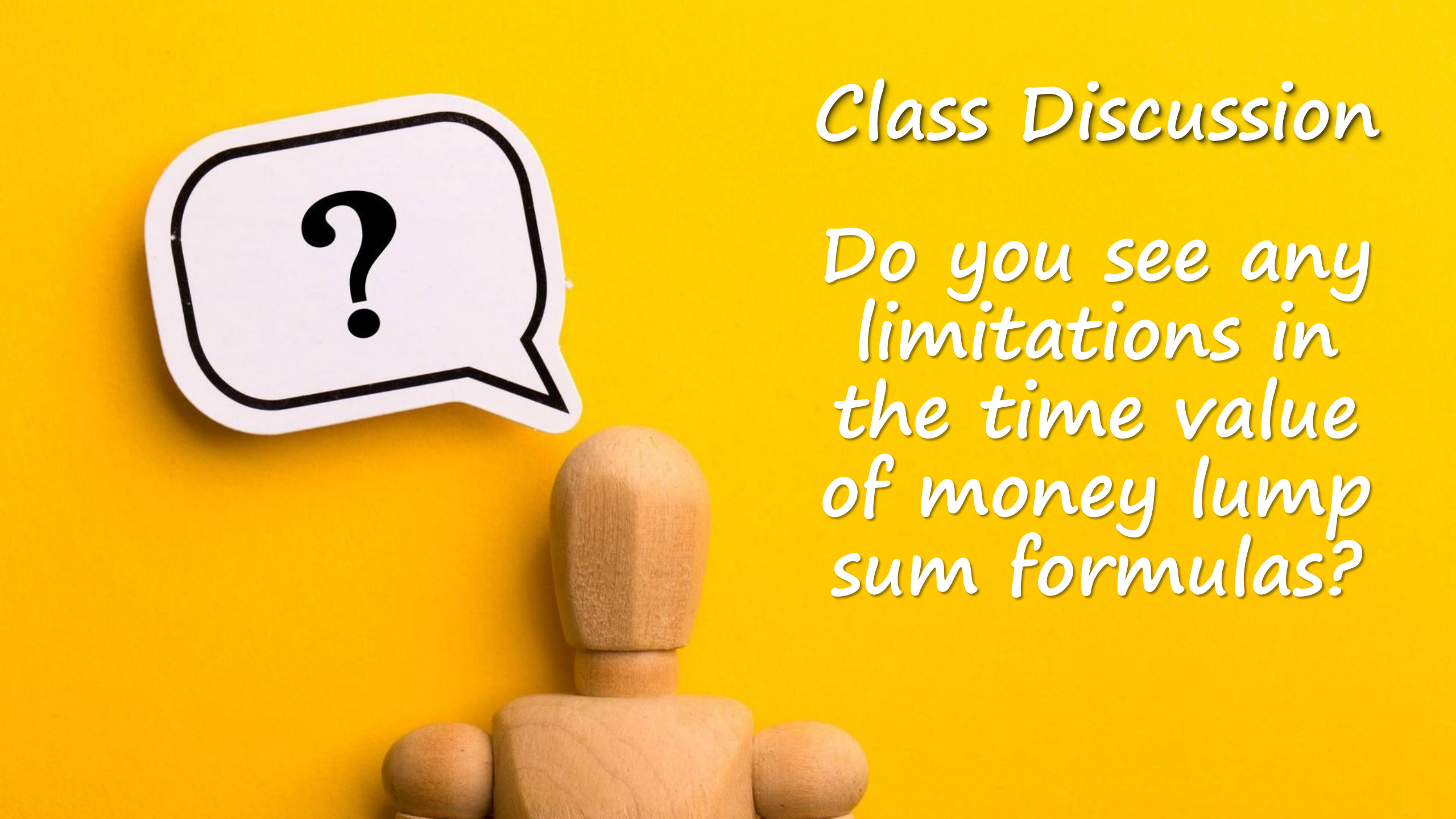
2 Interest Rates

When you save or invest, your **money earns interest and compounds**. A dollar today can grow. A dollar promised later can't.

3 Choices

Money in hand gives you **options now** — spend, save, invest, or wait. A promise of money later is only worth as much as the promise is kept.

FV	**Future Value**	***PV***	**Present Value**
	How much will my money grow?		**How much do I need today?**
r	**Interest Rate**	***t***	**Time**
	What rate do I need to reach my goal?		**How long before I save enough?**



Class Discussion

Do you see any limitations in the time value of money lump sum formulas?

Where the Lump Sum Formulas Fall Short

Two things FV, PV, r, and t can't handle alone

1 They Only Handle One Lump Sum

These formulas work with a single amount at a single moment in time. Money goes in once, or comes out once, but never both and never on repeat.

Example: Think of a $100 birthday check from grandma. You get it once, you invest it once, and the formula tracks that one amount.

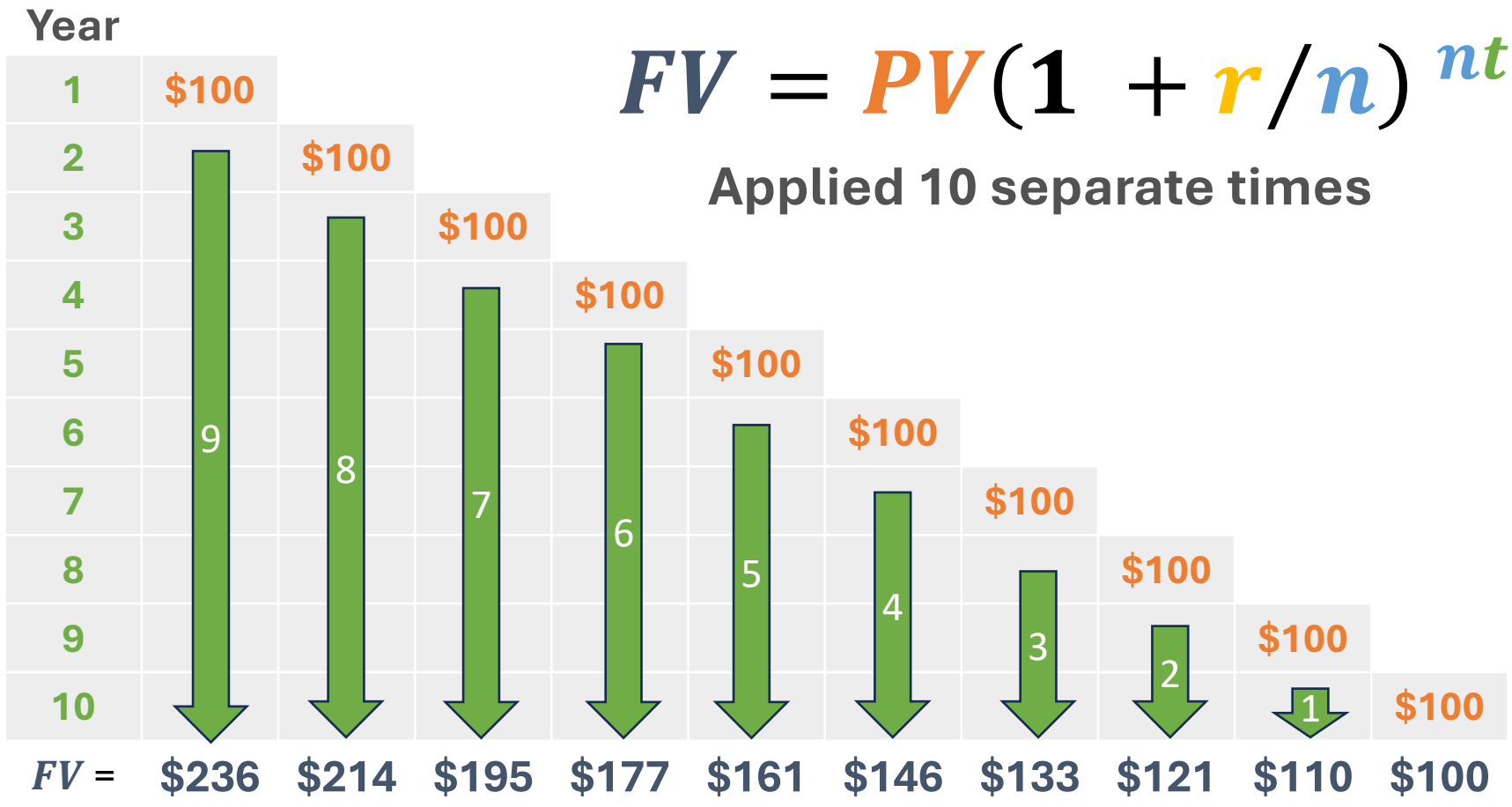
2 They Miss Recurring Cashflows

Real life is full of regular payments like paychecks, savings contributions, monthly bills, and withdrawals. Lump sum formulas can't keep up with money that moves again and again.

Example: Imagine saving $50 from every paycheck for college. That's lots of small deposits over time, not one big one. It needs a different kind of formula.

Visualizing Lump Sum Formula Limitations

*A student invests **$100** at the end of each year for 10 years, earning **10%** annual interest*



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

Applied 10 separate times

AFTER 10 YEARS

Total Invested

$1,000

Investment Gains

$594

FUTURE VALUE

$1,594

💡 **Surely, there must be a better way to calculate investment growth of these payments over time!** 🤔

What is an Annuity?

Think of it like an apple tree that drops fruit each year.

Annuity

A series of **equal payments** made at **regular intervals** over a **fixed period of time**.

Equal Payments

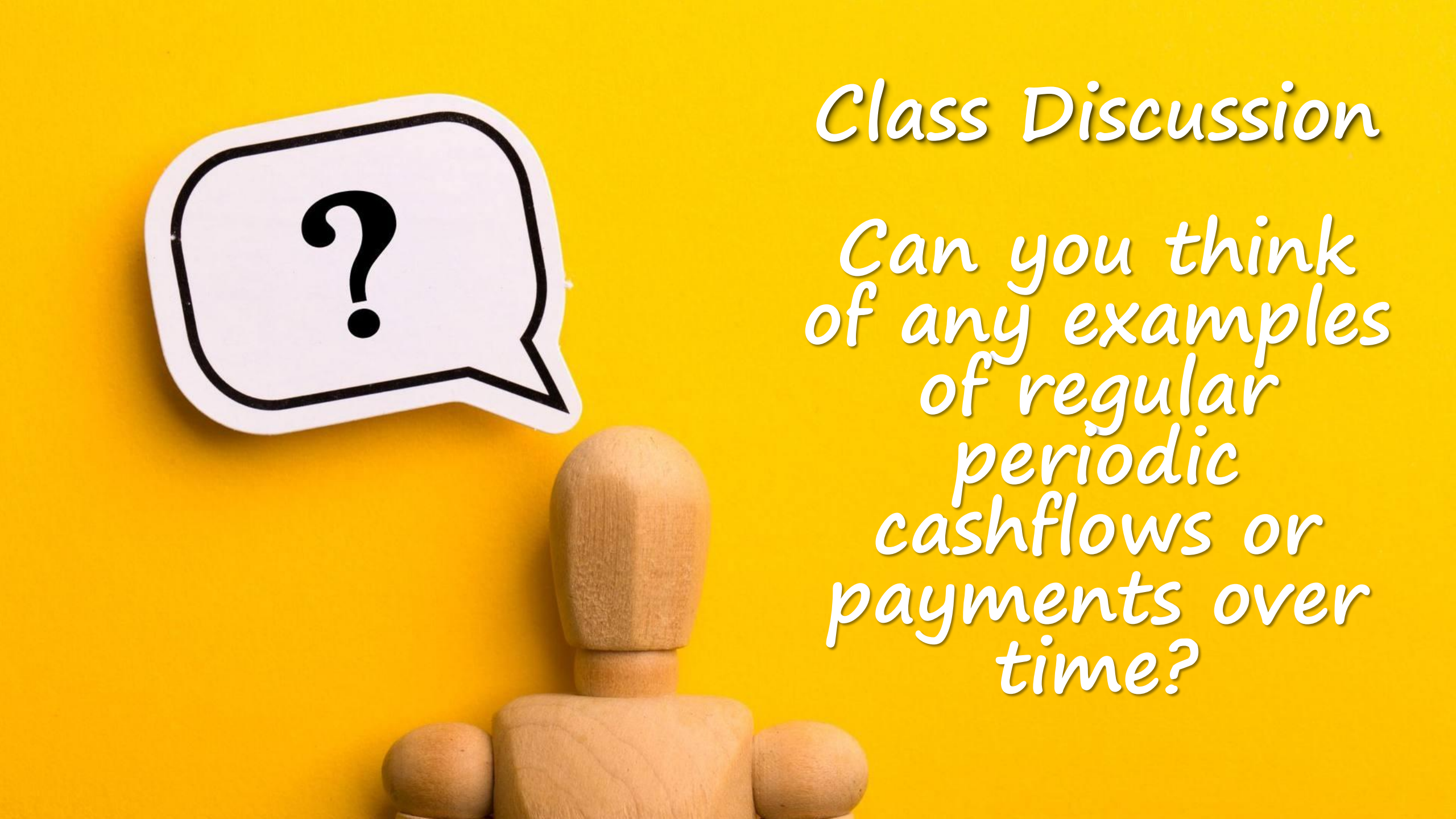
Every payment is the same size. Payments are not random. They do not change.

Regular Timing

Spaced evenly: weekly, monthly, quarterly, yearly, etc., but always the same gap.

Fixed Period

Has a clear start and end, so the number of payments are known.



Class Discussion

Can you think of any examples of regular periodic cashflows or payments over time?

Annuities Are Everywhere in Your Life

Anywhere money moves on a regular schedule — in or out

MONEY IN — *things you can earn or save on a schedule*

$10 / week

Allowance

Earned for chores like dishes, trash, or walking the dog.

$25 / Saturday

Side hustle

childcare, pet sitting, yard care services, etc.

$15 / week

Savings deposit

What you set aside in your savings account every Friday.

MONEY OUT — *things you pay for on a schedule*

$25 / month

Phone plan

Your share of the family plan or a prepaid SIM card.

$15 / month

Streaming Service

Netflix, Spotify, Disney+ — same charge every month.

$10 / month

Gaming pass

Roblox Premium, Minecraft Realms, or Fortnite battle pass.

*Each one is a small **annuity** — equal payments, on a regular schedule, for a known stretch of time.*

Who is Better Off at Age 65?

10% interest, compounded monthly: **14**-year-old investing **$100 / month**, or a **40**-year-old investing **$1,000 / month**?

14-year-old Invests

$61,200

= $100 per month x
12 months x 51 years

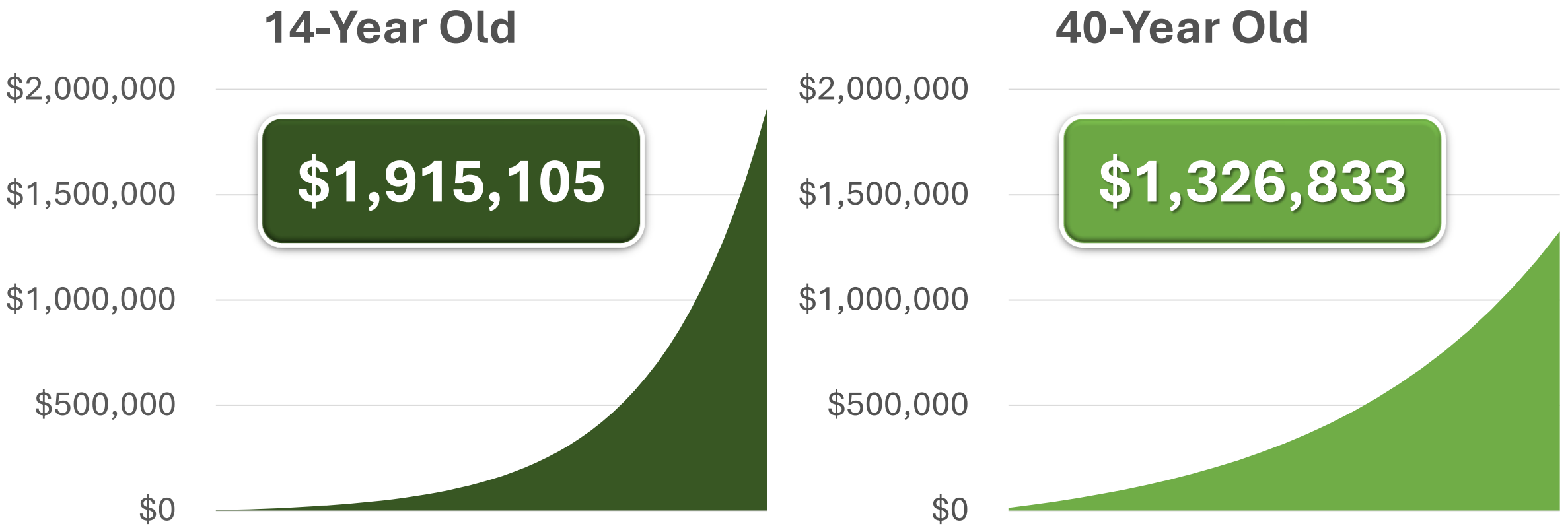
40-year-old Invests

$300,000

= $1,000 monthly x
12 months x 25 years

Who is Better Off at Age 65?

10% interest, compounded monthly: **14**-year-old investing **$100 / month**, or a **40**-year-old investing **$1,000 / month**?



💡 The 14-year-old invests 90% less per month and ends up with 44% more! **Are you paying attention?** 😲

What Can Annuity Formulas Solve?

Four kinds of recurring-payment questions, one family of formulas

FV

Future Value of Ordinary Annuity

How much your stream of regular deposits can grow into over time.

KEY QUESTION

How much will my contributions grow?

PV

Present Value of Ordinary Annuity

How much you need today to fund a future stream of regular payouts.

KEY QUESTION

How much do I need today to fund payouts?

N

Number of Payments for FV

How many periods of regular saving until you reach a future goal.

KEY QUESTION

How long to reach my goal?

N

Number of Payments for PV

How many periods until a balance is used up or a debt is paid off.

KEY QUESTION

How long until the balance is gone?

Practical Application

John is 13 years old. He earns a weekly allowance of $30 if he does his chores and homework. He wants to invest $15 per week in a stock portfolio. John estimates an average annual return of 8%. How much could his portfolio be worth in 5 years when he graduates high school?

How Much Will My Regular Savings Grow?

Future Value of an Ordinary Annuity Formula

$$FV = PMT\left(\frac{(1 + r/n)^{nt} - 1}{r/n}\right)$$

WHAT EACH VARIABLE MEANS

- FV **Future Value** = Ending amount
- PMT **Payment** = Amount deposited each period
- r **Interest Rate** = Annual rate as a decimal
- n **Payment Frequency** = Periods per year
- t **Time** = Years you keep contributing

WHAT "PMT" LOOKS LIKE IN PRACTICE

Even small, regular deposits add up over time

$PMT = \$15/wk$ → Allowance saving
$PMT = \$100/mo$ → First-job investing
$PMT = \$250/mo$ → Roth IRA contributions
$PMT = \$500/mo$ → 401(k) contributions

💡 Each contribution gets time to compound, and the earliest deposits grow the most.

Practical Application

John is 13 years old. He earns a weekly allowance of $30 if he does his chores and homework. He wants to invest $15 per week in a stock portfolio. John estimates an average annual return of 8%. How much could his portfolio be worth in 5 years when he graduates high school?

$$FV = PMT \cdot \left(\frac{\left(1 + \frac{r}{n}\right)^{n \cdot t} - 1}{\frac{r}{n}} \right)$$

Practical Application

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$$FV = PMT \cdot \left(\frac{\left(1 + \frac{r}{n}\right)^{n \cdot t} - 1}{\frac{r}{n}} \right) = 15 \cdot \left(\frac{\left(1 + \frac{.08}{52}\right)^{52 \cdot 5} - 1}{\frac{.08}{52}} \right)$$

Practical Application

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Practical Application

Janet is 17 years old getting ready for college. She estimates each year of tuition and housing cost $50,000. She plans to make her first $50,000 payment one year from today, then one payment each year thereafter, for four years. If her investment account earns 10% annually, how much money does she need today?

How Much Do I Need Today to Fund Payouts?

Present Value of an Ordinary Annuity Formula

$$PV = PMT\left(\frac{1-(1+r/n)^{-nt}}{r/n}\right)$$

WHAT EACH VARIABLE MEANS

- PV **Present Value** = Amount needed today
- PMT **Payment** = Payment amount each period
- r **Interest Rate** = Annual rate as a decimal
- n **Payment Frequency** = Periods per year
- t **Time** = Years payments last

WHAT "PMT" LOOKS LIKE IN PRACTICE

An amount today to fund equal future payments

Tuition → Annual college tuition payments
Phone Plan → Monthly phone bill
Subscription → Monthly gaming payments
Housing → Quarterly college housing

Future payments are worth less today because money can grow over time – remember time value of money!

Practical Application

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$$PV = PMT \cdot \left(\frac{1 - \left(1 + \frac{r}{n}\right)^{-n \cdot t}}{\frac{r}{n}} \right) = \$50,000 \cdot \left(\frac{1 - \left(1 + \frac{.1}{1}\right)^{-1 \cdot 4}}{\frac{.1}{1}} \right)$$

Practical Application

Janet is 17 years old getting ready for college. She estimates each year of tuition and housing cost $50,000. She plans to make her first $50,000 payment one year from today, then one payment each year thereafter, for four years. If her investment account earns 10% annually, how much money does she need today?

$$PV = PMT \cdot \left(\frac{1 - \left(1 + \frac{r}{n}\right)^{-n \cdot t}}{\frac{r}{n}} \right) = \$50,000 \cdot \left(\frac{1 - \left(1 + \frac{.1}{1}\right)^{-1 \cdot 4}}{\frac{.1}{1}} \right) = \$158,493.27$$

Practical Application

Jane is a middle school student enrolled in a financial education course.

From age 13 to age 18, Jane invests **$10 per week** from her allowance, in an investment account earning **10% average annual returns**.

Jane stops funding her investment account while she attends college.

Practical Application

1

PHASE 1 · CONTRIBUTING

Age 13 - 18

Saving from her allowance

PMT **$10 / week**

Time **5 years**

Source **weekly allowance**

FV of an Annuity

2

PHASE 2 · GROWING

Age 18 - 23

Money keeps compounding

PMT **No new deposits**

Time **5 more years**

Source **growth only**

FV of a Lump Sum

?

THE QUESTION

At Age 23

How big does it get?

Rate **10% / year**

Total in **$2,600**

Total out **$?**

Find out next slide

*Phase 1 → **annuity formula** · Phase 2 → **lump sum formula** · Same money, different math.*

Practical Application

THE SETUP

Jane invests **$10/week** from age 13 to 18, earning **10%/year**. She stops her contributions in college, but the account keeps growing until age 23.

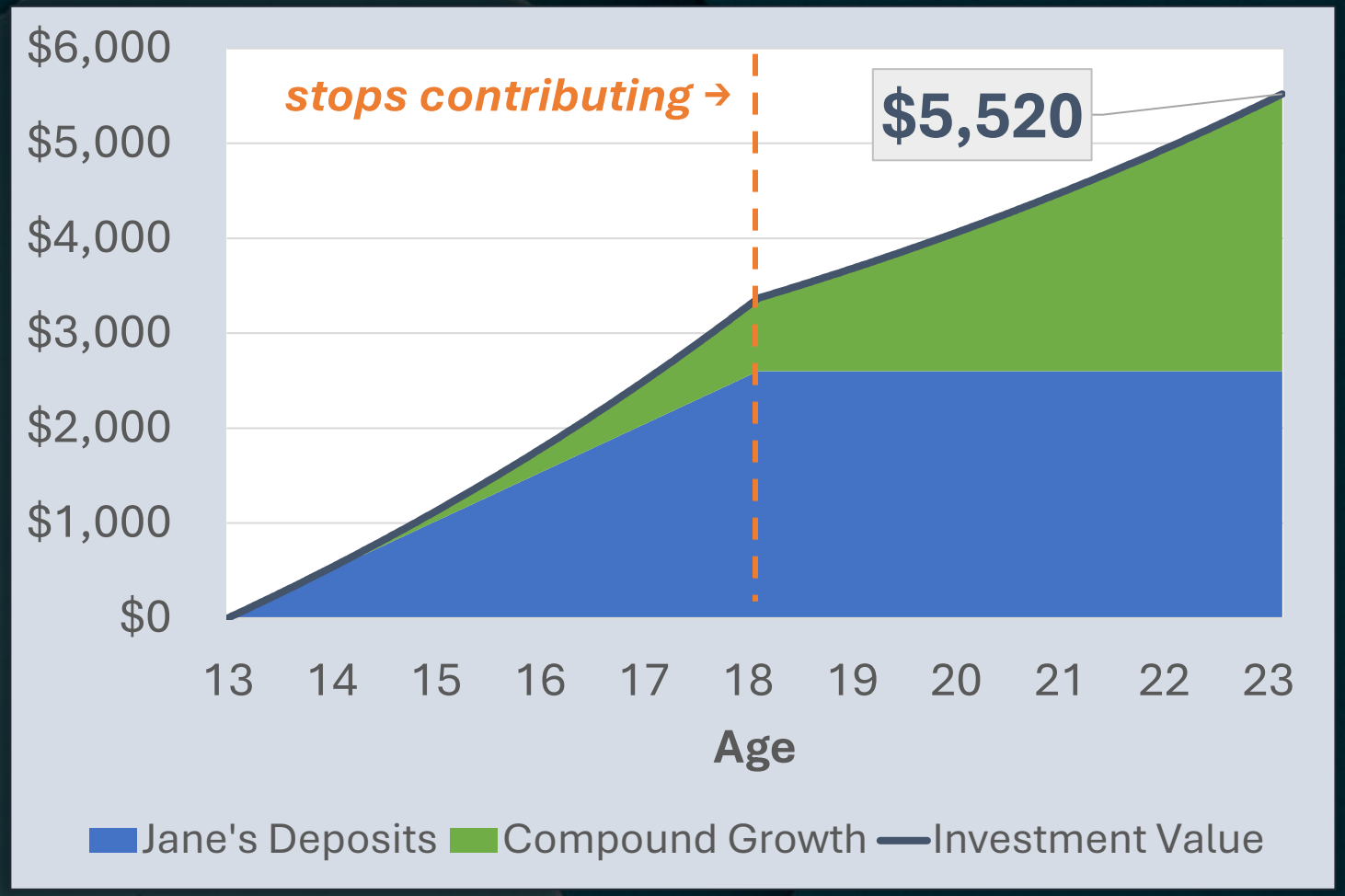
FUTURE VALUE AT AGE 23

$5,520

from $2,600 of her own money

$2,600
from deposits

$2,920
from growth



💡 More than half of Jane's ending balance came from compound growth!

How Many Payments Will It Take?

Solving an annuity for the total number of payment periods (N)

N — GROWING TO A SAVINGS GOAL

How many payments until I reach a future amount?

$$N = \frac{\ln\left(\frac{FV \cdot {}^{r}/_{n} + PMT}{PMT}\right)}{\ln\left(1 + {}^{r}/_{n}\right)}$$

N — PAYING DOWN A BALANCE

How many payments until a debt is gone?

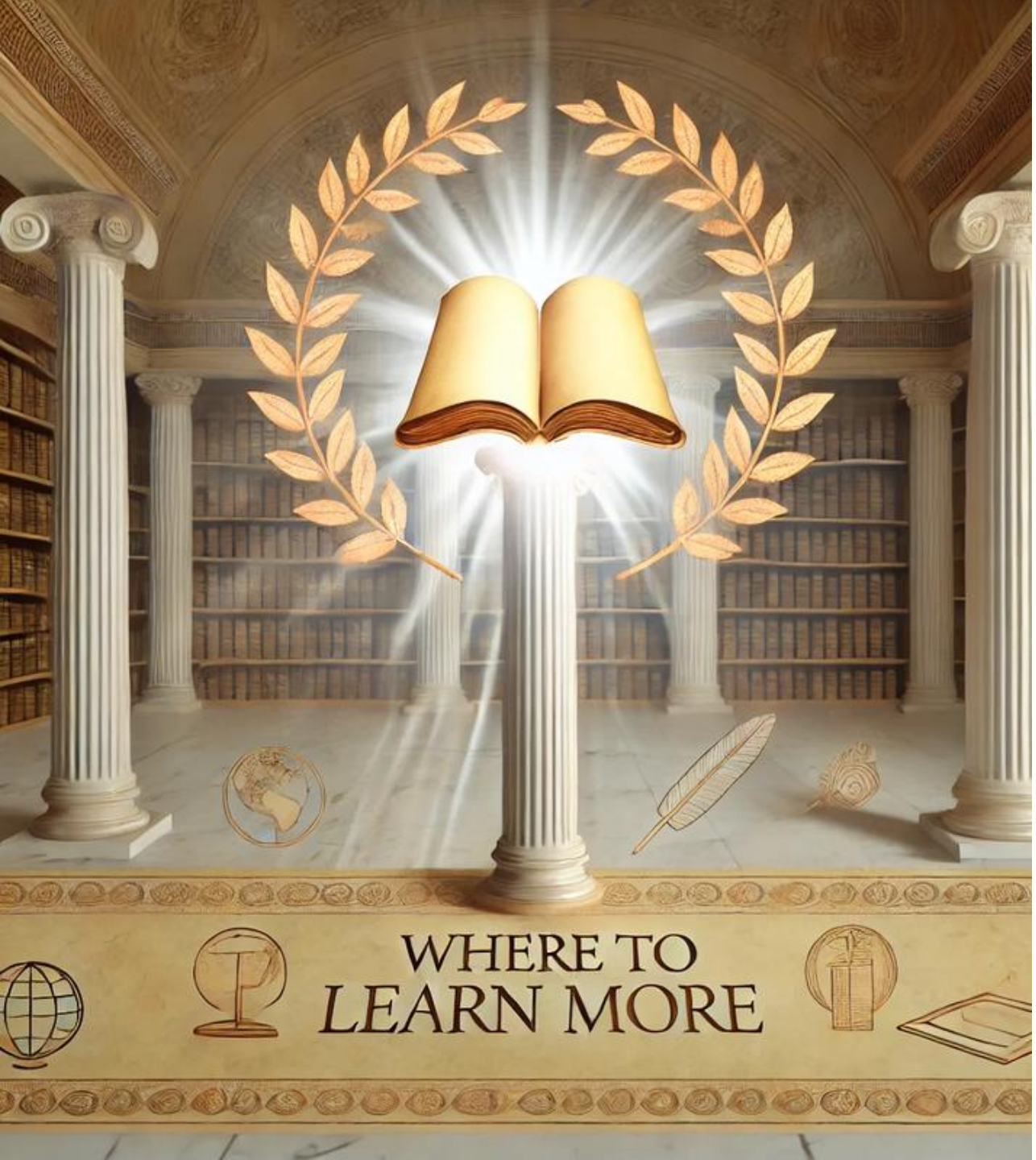
$$N = \frac{\ln\left(\frac{PMT}{PMT - PV \cdot {}^{r}/_{n}}\right)}{\ln\left(1 + {}^{r}/_{n}\right)}$$

- FV **Future Value** = Ending amount
- PV **Present Value** = Starting amount
- PMT **Payment** = Payment amount each period
- r **Interest Rate** = Annual rate as a decimal
- n **Payment Frequency** = Periods per year

💡 **ln** is the natural logarithm to unwind exponents. A spreadsheet =NPER() function finds the # of payments.

Three Key Takeaways

1. Annuities are regular periodic cashflows or payments over time.
2. Regular periodic cashflows into investment vehicles can grow significantly over time through cashflows and the power of compound interest.
3. You can use annuity formulas to plan better for your future.



Where to Learn More

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

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