Mr. G in Grade 9

Episode 3:
Fry's Bank Account

Last time on…

Mr. G in Grade 9


Now Playing
San Francisco
Foxygen
We Are the 21st Centur
4 of 9
1:54
-1:53
MENU
$380
iPod
160GB

There was this girl… Caroline

Picture not found.


Now Playing
San Francisco
Foxygen
We Are the 21st Centur
4 of 9
1:54
MENU
iPod
160GB

Around the same time, I was watching a TV show called “Futurama” and I saw this clip

Compound Interest - Futurama

Let's calculate how much Fry would have in his account using SIMPLE INTEREST

P = 93 cents
r = 2 ¼ % = 2.25%
t = 1000 years

$$\$0.93 \times 0.0225 \times 1000\ years = \$20.93\ (Interest)$$

$$\$0.93\ (Principal) + \$20.93\ (Interest) = \$21.86\ (Final\ Amount)$$

Usually banks use COMPOUND INTEREST

P = $100

r = 2% = 0.02

Another Example on Pg. 65 of Workbook

SIMPLE INTEREST	COMPOUND INTEREST
$\$100 \times 0.02 \times 1\ year + \$100 = \$102\ (After\ 1\ year)$	$\$100 \times 0.02 \times 1\ year + \$100 = \$102\ (After\ 1\ year)$
$\$100 \times 0.02 \times 2\ years + \$100 = \$104\ (After\ 2\ years)$	$\$102 \times 0.02 \times 1\ year + \$102 = \$104.04\ (After\ 2\ years)$
$\$100 \times 0.02 \times 3\ years + \$100 = \$106\ (After\ 3\ years)$	$\$104.04 \times 0.02 \times 1\ year + \$104.04 = \$106.12\ (After\ 3\ years)$
$\$100 \times 0.02 \times 4\ years + \$100 = \$108\ (After\ 4\ years)$	$\$106.12 \times 0.02 \times 1\ year + \$106.12 = \$108.24\ (After\ 4\ years)$

WITHOUT using a calculator, GUESS how much Fry has in his bank account!

Remember, using simple interest we got:

$$\$0.93\ (Principal) + \$20.93\ (Interest) = \$21.86\ (Final\ Amount)$$

Compound Interest - Futurama

$4.3 BILLION!!! = $4,300,000,000

BUT HOW!??!?!?

For COMPOUND INTEREST

P = $100

r = 2% = 0.02

Start $\$100$

After 1 year $A = \$100 \times (100\% + 2\%) = \$100 \times (1.02)$

After 2 years $A = [\$100 \times (1.02)] \times (100\% + 2\%) = [\$100 \times (1.02)](1.02)$

$= \$100 \times (1.02)^2$

After 3 years $A = [\$100 \times (1.02)^2] \times (100\% + 2\%) = [\$100 \times (1.02)^2](1.02)$

$= \$100 \times (1.02)^3$

After 4 years $A = [\$100 \times (1.02)^3] \times (100\% + 2\%) = [\$100 \times (1.02)^3](1.02)$

$= \$100 \times (1.02)^4$

Derivation on Pg. 65 of Workbook

$$A = P(1 + r)^t$$

A = Final Amount (NOT Interest)

P = Principal

r = Interest Rate (decimal)

t = Time (in years)

P = 93 cents

r = 2 ¼ % = 2.25%

t = 1000 years

$$\mathbf{A} = \boldsymbol{P}\,(\mathbf{1} + \boldsymbol{r})^{\boldsymbol{t}}$$

$$\$0.93\,(1 + 0.0225)^{1000\ years}$$

$$= \$4{,}283{,}508{,}450\ (Final\ Amount)$$

$$\$0.93\ (Principal) + \$20.93\ (Interest)$$

$$= \$21.86\ (Final\ Amount)$$

What if I saved my iPod Classic money instead of buying an iPod?

P = $380
r = 10% = 0.10
t = 50 years
(until I am 64 years old and retire)

SIMPLE INTEREST

$$\mathbf{I} = \boldsymbol{P} \cdot \boldsymbol{r} \cdot \boldsymbol{t}$$

$$\mathrm{I} = \$380 \times 0.10 \times 50\ years$$
$$\mathrm{A} = \$1900 + \$380 = \$2280$$

COMPOUND INTEREST

$$\mathbf{A} = \boldsymbol{P}\,(\mathbf{1} + \boldsymbol{r})^{\boldsymbol{t}}$$

$$\mathrm{A} = \$380\,(1 + 0.10)^{50\ years}$$
$$\mathrm{A} = \$44\,608.52$$

If you have the same interest rate and the same amount of time, compound interest will ALWAYS give more money!

This is why banks and credit cards use compound interest when they lend you money (So they can make more!)

The longer the time, the bigger the difference becomes!

Usually banks use COMPOUND INTEREST

P = $100

r = 2% = 0.02

Another Example on Pg. 65 of Workbook

SIMPLE INTEREST	COMPOUND INTEREST
$\$100 \times 0.02 \times 1\ year + \$100 = \$102\ (After\ 1\ year)$	$\$100 \times 0.02 \times 1\ year + \$100 = \$102\ (After\ 1\ year)$
$\$100 \times 0.02 \times 2\ years + \$100 = \$104\ (After\ 2\ years)$	$\$102 \times 0.02 \times 1\ year + \$102 = \$104.04\ (After\ 2\ years)$
$\$100 \times 0.02 \times 3\ years + \$100 = \$106\ (After\ 3\ years)$	$\$104.04 \times 0.02 \times 1\ year + \$104.04 = \$106.12\ (After\ 3\ years)$
$\$100 \times 0.02 \times 4\ years + \$100 = \$108\ (After\ 4\ years)$	$\$106.12 \times 0.02 \times 1\ year + \$106.12 = \$108.24\ (After\ 4\ years)$

Small difference

What if I saved my iPod Classic money instead of buying an iPod?

P = $380
r = 10% = 0.10
t = 50 years
(until I am 64 years old and retire)

SIMPLE INTEREST

$$I = P \cdot r \cdot t$$

$$I = \$380 \times 0.10 \times 50\ years$$
$$A = \$1900 + \$380 = \$2280$$

COMPOUND INTEREST

$$A = P\,(1 + r)^t$$

$$A = \$380\,(1 + 0.10)^{50\ years}$$
$$A = \$44\,608.52$$

BIG difference

Homework:

Worksheet

(Answers on the bottom of the back side)

Principal – How much money you borrowed or lent to someone

Interest – How much EXTRA money you owe or get

$$Final\ Amount\ (Future\ Value) = Principal + Interest$$

When you use compound interest, sometimes they will recalculate the interest during the year!

This is what compounding means! You recalculate how much is owed and charge interest on the new (bigger) amount.

Compounding Period – How often you recalculate interest in a year

Annual – 1 time per year

Semi-Annually – 2 times per year

Quarterly – 4 times per year

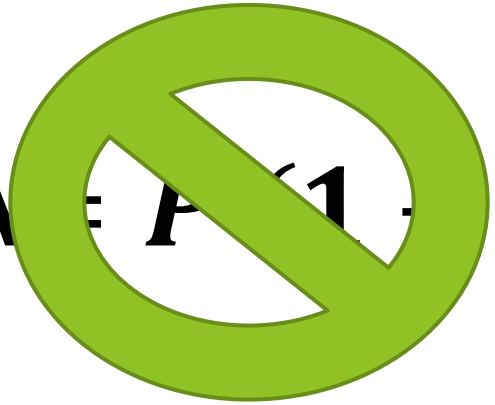
Monthly – 12 times per year

Daily – 365 times per year

Every Two Weeks – 26 times per year

Semi-monthly – 24 times per year

ANNUALLY	SEMI-ANNUALLY
	$\$100 \times 0.02 \times 0.5\ year + \$100 = \$101\ (After\ 0.5\ year)$
$\$100 \times 0.02 \times 1\ year + \$100 = \$102\ (After\ 1\ year)$	$\$101 \times 0.02 \times 0.5\ year + \$101 = \$102.01\ (After\ 1\ year)$
	$\$102.01 \times 0.02 \times 0.5\ year + \$102.01 = \$103.03\ (After\ 1.5\ years)$
$\$102 \times 0.02 \times 1\ year + \$102 = \$104.04\ (After\ 2\ years)$	$\$103.03 \times 0.02 \times 0.5\ year + \$103.03 = \$104.06\ (After\ 2\ years)$
	$\$104.06 \times 0.02 \times 0.5\ year + \$104.06 = \$105.10\ (After\ 2.5\ years)$
$\$104.04 \times 0.02 \times 1\ year + \$104.04 = \$106.12\ (After\ 3\ years)$	$\$105.10 \times 0.02 \times 0.5\ year + \$105.10 = \$106.15\ (After\ 3\ years)$
	$\$106.15 \times 0.02 \times 0.5\ year + \$106.15 = \$107.21\ (After\ 3.5\ years)$
$\$106.12 \times 0.02 \times 1\ year + \$106.12 = \$108.24\ (After\ 4\ years)$	$\$107.21 \times 0.02 \times 0.5\ year + \$107.21 = \$108.29\ (After\ 4\ years)$



$$A = P(1 + r)^t$$

$$A = P\left(1 + \frac{r}{n}\right)^{nt}$$

A = Final Amount (NOT Interest)

P = Principal

r = Interest Rate (decimal)

t = Time (in years)

n = number of compounding periods in a year

Simple Interest

$$I = P \cdot r \cdot t$$

Compound Interest

$$A = P\left(1 + \frac{r}{n}\right)^{nt}$$

I = Interest
A = Final Amount
P = Principal
r = Interest Rate (decimal)
t = Time (in years)
n = number of compounding periods in a year