For loans or investments that are longer than one year, compound interest is used. Whether it is calculating interest in a bank account, a car loan, a mortgage, etc. compound interest is everywhere.

Today we would like to find a formula, that is easy to use, and will help us solve interest problems quickly and efficiently. For some, this may be review from last year.

Consider the following scenario:

1) Bryden's grandparents give him $500 on his 3rd birthday to open up a savings account. His savings account has a compound interest rate of 2% compounded yearly. How much will Bryden have in 10 years? 20 years? 30 years?

↳ 0.02

a) To start, we will do one more of these tables to help motivate a formula.

Year	Starting Balance	Rule for Calculating Ending Balance (2%/year)	Ending Balance
1	$500	× 1.02	$510
2	$510	× 1.02	$520.20
3		× 1.02	$530.60
4		× 1.02	$541.22
5		× 1.02	$552.04
6		× 1.02	$563.08
7		× 1.02	$574.34
8		× 1.02	$585.83
9		× 1.02	$597.55
10		× 1.02	$609.50

← Amount in his savings account!

1.02

b) Notice how we just multiplied by ~~1.05~~ ten times? There is a shorter way of doing this on our calculators!

Instead of.... $500 \times 1.02 \times 1.02 \times \ldots\ldots \times 1.02 = \$609.50$

We can do... $500 \times (1.02)^{10} = \$609.50$

c) Try the following calculation to see how much Bryden would have in 20 and 30 years:

i) ~~500(1.09)^20~~

$500(1.02)^{20} = \$742.97$

ii) ~~500(1.09)^30~~

$500(1.02)^{30} = \$905.68$

This leads to an easy to use formula to find the final amount of a loan or investment with yearly compound interest:

Interest Rate (decimal)

$$A = P(1+r)^t \leftarrow \text{Years}$$

Principal (Initial Amount)

Note: Many real world applications have interest that is calculated every month, or even every week. We will solve these problems with technology.

Let's try a couple of examples:

1) Andrew borrows $2000 to purchase a new gaming laptop. He agrees to pay it back in full 2 years later, and agrees to a yearly compound interest rate of 4%. How much will he pay back in the future?

Variables	Calculations: $A = P(1+r)^t$
Principal (P) = 2000	$= 2000(1.04)^2$
Rate (r) = 0.04	$= \$2,163.20$
Time (t) = 2	
Conclusion: Andrew pays back $\$2,163.20$. He was charged $2,163.20 - 2,000 = \$163.20$ in interest	

2) It's Asher's time to get some birthday money. He receives $100 on his 1st birthday, and Mr. Smith puts it in a TFSA (tax free savings account) with a yearly compound interest rate of 2.5%. How much will Asher have in 18 years? How much interest did he make?

Variables	Calculations: $A = P(1+r)^t$
Principal (P) = 100	$= 100(1.025)^{18}$
Time (t) = 18	$= \$155.97$
Rate (r) = $2.5/100 = 0.025$	
Conclusion: Asher has $\$155.97$ in 18 years. He made $\$155.97 - 100 = \$55.97$	