Interest can be calculated in two different ways: simple and compound. Last section you learned to calculate interest using the simple interest formula: \( I = P \times r \times t \). This formula calculates the interest only. The new amount \( (A) \) can be determined by adding the original amount/principle \( (P) \) to the interest earned \( (I) \): \( A = P + I \). Simple interest is a calculation based on the original principle only. Over time, the amount of interest earned is year is the same. For example, an investment earns 4% annual interest. Each year, a $1000 investment will earn $40. After the first year the total is $1040, the second year total is $1080, and the third year is $1120.

Compound interest is the common method of calculating interest. While it is more common, it is also a more challenging computation. In compound interest, your interest earns interest. This means that each year your interest is calculated on the new total, not just the original amount.

Example A: The comparison of an investment of $1000 at 4% annual interest for 5 years, showing the annual totals.

<table>
<thead>
<tr>
<th>Year</th>
<th>Simple Interest</th>
<th>Compound Interest</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Interest: 1000(0.04)(1) = $40</td>
<td>Interest: 1000(0.04)(1) = $40</td>
</tr>
<tr>
<td></td>
<td>Total: 1000 + 40 = $1040</td>
<td>Total: 1000 + 40 = $1040</td>
</tr>
<tr>
<td>2</td>
<td>Interest: 1000(0.04)(2) = $80</td>
<td>Interest: 1040(0.04)(1) = $41.60</td>
</tr>
<tr>
<td></td>
<td>Total: 1000 + 80 = $1080</td>
<td>Total: 1040 + 41.60 = $1081.60</td>
</tr>
<tr>
<td>3</td>
<td>Interest: 1000(0.04)(3) = $120</td>
<td>Interest: 1081.60(0.04)(1) = $43.26</td>
</tr>
<tr>
<td></td>
<td>Total: 1000 + 120 = $1120</td>
<td>Total: 1081.60 + 43.26 = $1124.86</td>
</tr>
<tr>
<td>4</td>
<td>Interest: 1000(0.04)(4) = $160</td>
<td>Interest: 1124.86(0.04)(1) = $44.99</td>
</tr>
<tr>
<td></td>
<td>Total: 1000 + 160 = $1160</td>
<td>Total: 1124.86 + 44.99 = $1169.85</td>
</tr>
<tr>
<td>5</td>
<td>Interest: 1000(0.04)(5) = $200</td>
<td>Interest: 1169.85(0.04)(1) = $46.79</td>
</tr>
<tr>
<td></td>
<td>Total: 1000 + 200 = $1200</td>
<td>Total: 1169.85 + 46.79 = $1216.64</td>
</tr>
</tbody>
</table>

According to the example, simple interest is always based on the original amount/principle. Therefore the interest earned each year is constant: $40. However, in compound interest, the interest is calculated on the new total amount of money each year. After the first year, both simple and compound interest are the same: $1040. However in the second year, compound interest is based on the new total, $1040, whereas simple interest is still calculated on the original $1000. By the end of five year, the compound interest calculation has earned $16.64 more than the simple interest. Over time, this difference will become greater and greater.

The following is the formula for yearly compound interest.

\[ A = P(1 + r)^t \]

Where \( A \) is the total new total amount of money after an initial amount \( (P) \) is earning \( r \) annual percent for \( t \) years. The annual percentage rate, \( r \), is in decimal form.

Example B: $5000 is deposited into a savings account earning 2.86%. How much is the savings account worth if left untouched for 4 years, if the interest is compounded yearly?

Use the yearly compound interest formula: \( A = P(1 + r)^t \).

\[ P = 5000, \ r = 0.0286, \ \text{and} \ t = 4. \]

After substitution:

\[ A = 5000(1 + 0.0286)^4 \]

Follow the order of operations

\[ A = 5000(1.0286)^4 \]  

Do not round

\[ A = 5000(1.119402004) \]  

Do not round

\[ A = 5597.010018 \]  

Rounding to the nearest cent

\[ A = 5597.01 \]

The savings account is worth $5597.01 after 4 years.

A calculator must be used to answer compound interest questions. To calculate \((1.0286)^4\), either use a calculator to multiply: \((1.0286)(1.0286)(1.0286)(1.0286)\), or use the exponent button on your calculator. The exponent button looks like: \(\text{YX} \) or \(\square\).

To input \((1.0286)^4\) do the following: 1.0286 \(\text{YX} \) 4 or 1.0286 \(\square \) 4.

Example C: What is the interest earned after 2 years if $2500 is deposited into a certificate of deposit earning 3.4% annual interest?

\[ A = 2500(1 + 0.034)^2 \]

calculator sequence: 2500 \(\times\) 1.034 \(\square \) 2 \text{ ENTER} \]

\[ A = 2672.89 \]

The balance after 2 years is $2672.89.

Interest earned is total amount, \( A \), less the principle, \( P \) \((I = A - P)\).

This means that $172.89 has been earned in interest. \((I = 2672.89 - 2500)\)
You may do all work on this page. Use a calculator, showing steps.

Determine the **balance** \((A)\) and the amount of **interest** \((I)\) earned for the following questions, when:

a. the account is earning simple interest \((I = Prt, A = P + I)\)
b. the account is earning yearly compounded interest \((A = P(1 + r)^t, I = A - P)\)

1. $3000 is invested at 3% annual interest for 3 years.
   - a. Simple Interest
   - b. Compound Interest

2. $1234 is invested at 5.6% annual interest for 7 years.
   - a. Simple Interest
   - b. Compound Interest

3. $10,000 is invested at 0.75% annual interest for 2 years.
   - a. Simple Interest
   - b. Compound Interest

4. $987.65 is invested at 0.4% annual interest for 5 years.
   - a. Simple Interest
   - b. Compound Interest

5. $500 is invested at 4.3% annual interest for 18 months.
   - a. Simple Interest
   - b. Compound Interest

6. $1000 is invested at 2.9% annual interest for 6 months.
   - a. Simple Interest
   - b. Compound Interest