Principal and Interest

Example 1

Michael is saving money to buy a car. He takes **$8,000** to the bank and opens an annual CD upon which the bank agrees to pay him **2%** interest.

```
Principal    = 8000
Term         = 1 year
APR          = 2% = 0.02
8000 x 0.02 = $160
8000 + 160  = $8,160
```

Beginning Balance	2% Interest	Ending Balance
$8,000	$160	$8,160

After one year, Michael has earned **$160** in interest on his initial deposit of $8,000, so his balance is now **$8,160.**

Annual Compounding: Certificate of Deposit

Example 2

Now, let's say Michael leaves his money in the bank for four years. The term of the annual CD is four years, so he will be earning **2%** interest per year for **four years.** Since this is an annual CD, interest will be added to the principal at the end of every year. This is called **annual compounding.**

	Beginning Balance	2% Interest	Ending Balance
Year 1	$8,000.00	$160.00	$8,160.00
Year 2	$8,160.00	$163.20	$8,323.20
Year 3	$8,323.20	$166.46	$8,489.66
Year 4	$8,489.66	$169.79	$8,659.45

Now You Try

Ask students to do page 9 of the Now You Try student worksheet.

Quarterly Compounding: Statement Savings Account

Example 3

Michael's bank offers other types of investment accounts in addition to certificates of deposit. One such type of account is a **statement savings account.** This type of account is similar to a certificate of deposit in that it also pays an annual percentage rate (APR) of interest, but there are some differences, too.

A statement savings account doesn't require Michael to promise not to take the money out for a specific period of time. Michael can go in and withdraw his money any time he wants. Also, instead of paying Michael his interest only once per year (annually), the bank will make an interest payment deposit into his account at the end of every quarter, because statement savings accounts compound quarterly.

When the bank makes an interest payment, the interest Michael earned during that quarter is added to his principal, and the new balance becomes Michael's new principal balance for the next quarter. Now Michael will begin earning interest on his interest! This is called **compound interest.**

Let's say Michael takes his $8,000 to the bank and opens a statement savings account instead of a certificate of deposit. The bank is going to pay him the same 2% interest on this account that it was offering for the CD.

Michael's beginning principal amount is again **$8,000.** Also, his APR is still 2%. However, Michael gets **interest compounded quarterly** on this account.

At the end of the 4th quarter, what will Michael's principal balance be?

1. First, calculate his annual interest: 8000 x 0.02 = $160
2. Next, calculate what his 1st quarter interest payment will be: 160/4 = $40
3. **At the end of the 1st quarter,** Michael's new principal balance will be **$8,040.**
4. Next, calculate the annual interest he will earn on $8,040: 8040 x 0.02 = $160.80
5. Calculate his 2nd quarter interest payment: 160.80/4 = $40.20
6. **At the end of the 2nd quarter,** Michael's new principal balance will be 8040 + 40.20 = **$8,080.20.**
7. Next, calculate the annual interest he will earn on $8,080.20: 8080.20 x 0.02 = $161.60
8. Calculate his 3rd quarter interest payment: 161.60/4 = $40.40
9. **At the end of the 3rd quarter,** Michael's new principal balance will be 8080.20 + 40.40 = **$8,120.60.**
10. Finally, calculate the annual interest he will earn on $8,120.60: 8120.60 x 0.02 = $162.41
11. Calculate his 4th quarter interest payment: 162.41/4 = $40.60
12. **At the end of the 4th quarter,** Michael's new principal balance will be 8120.60 + 40.60 = **$8,161.20.**

After four quarters have passed, Michael has had his money in the statement savings account for one year. His ending balance at the end of that year is **$8,161.20.**

Do you remember what his ending balance would have been if he had opened an annual CD instead? **($8,160)**

Quarterly Compounding: Statement Savings Account

Example 3—continued

Let's compare these two choices.

▶ Which type of account would have earned Michael more interest? **(Statement savings account)**

▶ How much *more* interest would Michael earn by opening the statement savings account instead of the annual CD? **($1.20)**

Why? After all, *both* accounts pay the same 2% APR.

If 2% of $8,000 is $160, and he earned $161.20 on his principal in the statement savings account, then he must have actually earned *more* than 2% in the statement savings account.

This is because he earned interest on his interest during the year. His statement savings account yielded more than 2% for the year. This extra earning because of compounding interest is called **annual percentage yield,** or **APY**. APY is the actual rate your money earns, taking compounding into consideration.

To calculate the APY, we divide the amount of interest Michael earned for the year by his original principal deposit:

$$\text{APY} = \frac{161.2}{8000} = 0.02015 \textbf{ = 2.015\%}$$

So a statement savings account that pays an **APR of 2%** will earn an **APY of 2.015%** because of the effect of compound interest.

Now You Try

Ask students to do page 10 of the Now You Try student worksheet.

Monthly Compounding: Money Market Savings Account

Example 4

Michael's bank offers another type of investment account similar to the statement savings account. This account is called a **money market savings account.** This type of account works just like a statement savings account except that the compounding period is monthly instead of quarterly. This means that Michael will receive an interest payment deposit into his account at the end of every month.

When that happens, the interest Michael earned in the previous month is added to his principal, and the new balance becomes Michael's new principal balance for the next month. So now Michael will begin earning interest on his interest monthly!

This time, Michael takes his $8,000 to the bank and opens a money market savings account instead of a statement savings account. The bank is going to pay him the same 2% on this account that it was offering for the statement savings account.

Michael's beginning principal amount is again **$8,000.** Also, his APR is still **2%.** However, Michael gets **interest compounded monthly** on this account.

After three months, or one quarter, what will Michael's principal balance be?

1. First, calculate his annual interest: 8000 x 0.02 = $160

2. Next, calculate what his 1st month's interest payment will be: 160/12 = $13.33

3. **At the end of the 1st month,** Michael's new principal balance will be **$8,013.33.**

4. Next, calculate the annual interest he will earn on $8,013.33: 8013.33 x 0.02 = $160.27

5. Calculate his 2nd month's interest payment: 160.27/12 = $13.36

6. **At the end of the 2nd month,** Michael's new principal balance will be 8013.33 + 13.36 = **$8,026.69.**

7. For the 3rd month, calculate the annual interest he will earn on $8,026.69: 8026.69 x 0.02 = $160.53

8. Calculate his 3rd month's interest payment: 160.53/12 = $13.38

9. **At the end of the 3rd month,** Michael's new principal balance will be 8026.69 + 13.38 = **$8,040.07.**

At the end of three months, we have completed the 1st quarter.

What would Michael's balance have been at the end of the 1st quarter if he had a statement savings account compounding quarterly? **($8,040)**

If we continue for all 12 months of the year:

	Beginning Balance	2% Interest	Ending Balance
1st month	$8,000.00	$13.33	$8,013.33
2nd month	$8,013.33	$13.36	$8,026.69
3rd month	$8,026.69	$13.38	$8,040.07
4th month	$8,040.07	$13.40	$8,053.47
5th month	$8,053.47	$13.42	$8,066.89
6th month	$8,066.89	$13.44	$8,080.33
7th month	$8,080.33	$13.47	$8,093.80
8th month	$8,093.80	$13.49	$8,107.29
9th month	$8,107.29	$13.51	$8,120.80
10th month	$8,120.80	$13.53	$8,134.33
11th month	$8,134.33	$13.56	$8,147.89
12th month	$8,147.89	$13.58	$8,161.47

Note: We rounded *up* the monthly interest calculation before we added a month's interest to the balance at the beginning of the month. There may be as much as a $0.03 difference at the end of the year. This $0.03 difference still yields the same APY.

Michael's $8,000 original principal deposit, put into a money market savings account at 2% APR, compounding monthly, would be worth **$8,161.47** at the end of one year.

What APY does this account yield? Again, divide the amount of interest Michael earned for the year by his original principal deposit:

$$APY = \frac{161.44}{8000} = 0.02018 = \textbf{2.018\%} \quad \textbf{OR} \quad APY = \frac{161.47}{8000} = 0.02018 = \textbf{2.018\%}$$

Now You Try

Ask students to do page 11 of the Now You Try student worksheet.

Compare Annual vs. Quarterly vs. Monthly Compounding

Discussion Questions

▶ If the APR is the same on all three investments, which is the best investment? **(The investment with the greatest number of compounding periods.)**

▶ How do you think a bank might entice you to open a CD or statement savings account instead of money market accounts? **(By offering a higher APR on products that have fewer compounding periods.)**

Assessment

Ask students to complete the assessment worksheet.