

Money Math for Teens

Introduction to Earning Interest: Middle School Version





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Introduction to Earning Interest: APR, APY and Compound Interest

Middle School Lesson Plan

OBJECTIVE

Saving and investing money safely and wisely are critical skills for people of all ages and backgrounds. Armed with the knowledge of how investments work, savvy investors can make informed decisions and determine the best investment choices available to them.

Students will:

- ▶ Learn and use investment vocabulary
- ▶ Discover the concept of compound interest and understand its effect on savings
- ▶ Compute simple and compound interest over a variety of compounding periods.

TEACHING MATERIALS

- ▶ Lesson plan
- ▶ Teacher worksheet with precalculated examples
- ▶ Now You Try student worksheet with solutions
- ▶ Student assessment worksheet with solutions

LESSON ACTIVITY

1. **Discuss vocabulary words principal, deposit, interest, term, APR and APY.**
2. **Certificate of deposit (CD):**
 - Compounds annually.
 - Work through precalculated examples of annual compounding (see teacher worksheet, Examples 1 and 2).
 - Now You Try student worksheet: practice annual interest calculations (page 9).
3. **Statement savings account:**
 - Compounds quarterly.
 - Work through precalculated example of quarterly compounding (see teacher worksheet, Example 3).
 - *Note:* The calculations presented do not take into account that different months have different numbers of days. Quarterly calculations are done by computing annual interest, then dividing by 4.
 - Emphasize that annual interest paid quarterly > annual interest paid annually.
 - Define and demonstrate how to calculate APY.
 - Now You Try student worksheet: practice quarterly interest calculations (page 10).



Introduction to Earning Interest: APR, APY and Compound Interest

4. **Money market savings account:**
 - Compounds monthly.
 - Work through precalculated example of monthly compounding (see teacher worksheet, Example 4).
 - *Note:* The calculations presented do not take into account that different months have different numbers of days. Monthly calculations are done by computing annual interest, then dividing by 12.
 - Calculate APY for the example.
 - Now You Try student worksheet: practice monthly interest calculations (page 11).
5. **Discussion: compare and contrast annual, quarterly and monthly compounding.**
6. **Evaluate students' comprehension (see assessment worksheet).**



Introduction to Earning Interest: APR, APY and Compound Interest

Teacher Worksheet

Vocabulary

Principal: An amount of money owned by an investor and held by a financial institution such as a bank.

Deposit(s): The act of establishing, or adding to, existing principal in an account (verb); the money placed in the account (noun).

Interest: The amount of money you earn by leaving deposits in a bank or financial institution. Interest is a percentage of your principal.

Term: The period of time an investment lasts.

Annual percentage rate (APR): The percentage rate at which interest is calculated annually.

Certificate of deposit (CD): An agreement between an investor and a bank (or financial institution) whereby the investor agrees to put a certain amount of money on deposit (this is the principal) for a certain amount of time without withdrawing it (this is the term) and the bank agrees to pay the investor interest at an agreed-upon percentage rate, known as the **annual percentage rate (APR)**.

Compounding period: The amount of time that elapses between interest payments.

- ▶ **Annual compounding:** once per year
- ▶ **Quarterly compounding:** once every three months
 - January – March: 1st quarter
 - April – June: 2nd quarter
 - July – September: 3rd quarter
 - October – December: 4th quarter
- ▶ **Monthly compounding:** once per month

Compound interest: Interest calculated on both the principal you have on deposit and on interest that has accumulated in the past.



Introduction to Earning Interest: APR, APY and Compound Interest

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
 $8000 \times 0.02 = \mathbf{\$160}$
 $8000 + 160 = \mathbf{\$8,160}$

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.



Introduction to Earning Interest: APR, APY and Compound Interest

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: $8000 \times 0.02 = \$160$
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: $8040 \times 0.02 = \$160.80$
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 $8040 + 40.20 = \mathbf{\$8,080.20}$.
7. Next, calculate the annual interest he will earn on \$8,080.20: $8080.20 \times 0.02 = \$161.60$
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 $8080.20 + 40.40 = \mathbf{\$8,120.60}$.
10. Finally, calculate the annual interest he will earn on \$8,120.60: $8120.60 \times 0.02 = \$162.41$
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 $8120.60 + 40.60 = \mathbf{\$8,161.20}$.

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**)



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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:

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

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.



Introduction to Earning Interest: APR, APY and Compound Interest

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: $8000 \times 0.02 = \$160$
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: $8013.33 \times 0.02 = \$160.27$
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: $8026.69 \times 0.02 =$ \$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**)



Introduction to Earning Interest: APR, APY and Compound Interest

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:

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

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.



Name _____

Date _____

Student Worksheet

NOW YOU TRY: APR, APY AND COMPOUND INTEREST

Annual Interest

1. Andrea wants to invest **\$2,000** at her bank. She picks an annual certificate of deposit that will pay her **3%** interest each year.

(Remember, 3% is 0.03 when written as a decimal.)

A. How much interest will Andrea earn for the year?

B. What will Andrea's balance be after one year?

2. Now, let's say Andrea decides to leave her money in the bank for three years.

A. What is the term of Andrea's certificate of deposit?

B. Fill in the table to find out how Andrea's investment grows.

	Beginning Balance	3% Interest	Ending Balance
Year 1	\$2,000.00		
Year 2			
Year 3			



Name _____	Date _____
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Annual vs. Quarterly Interest

3. Andrea wants to invest **\$2,000** at her bank. She decides to open a statement savings account, which compounds quarterly, instead of an annual certificate of deposit. This statement savings account will pay her a **3%** APR.

(Remember, 3% is 0.03 when written as a decimal.)

A. How often does Andrea’s account compound?

B. What will Andrea’s 1st quarter interest payment be?

C. What will Andrea’s balance be when the year is over?

	Beginning Balance	3% Interest	Ending Balance
1st quarter	\$2,000.00		
2nd quarter			
3rd quarter			
4th quarter			

D. What APY will Andrea’s statement savings account earn for the year?



Name _____

Date _____

Quarterly vs. Monthly Interest

Andrea wants to invest **\$2,000** at her bank. She decides to open a money market savings account, which compounds monthly, instead of a statement savings account. This money market savings account will pay her a **3%** APR.

(Remember, 3% is 0.03 when written as a decimal.)

	Beginning Balance	3% Interest	Ending Balance
1st month	\$2,000.00		
2nd month			
3rd month			
4th month			
5th month			
6th month			
7th month			
8th month			
9th month			
10th month			
11th month			
12th month			

4. What APY will Andrea's money market savings account earn for the year?



Introduction to Earning Interest: APR, APY and Compound Interest

Student Worksheet: Solutions

Annual Interest

1. Andrea wants to invest **\$2,000** at her bank. She picks an annual certificate of deposit that will pay her **3%** each year. (*Remember, 3% is 0.03 when written as a decimal.*)

A. How much interest will Andrea earn for the year?

$$\text{Interest} = 2000 \times 0.03 = \mathbf{\$60}$$

B. What will Andrea's balance be after one year?

$$\text{Balance} = \text{Principal} + \text{Interest}$$

$$\text{Balance} = 2000 + (2000 \times 0.03)$$

$$\text{Balance} = 2000 + 60 = \mathbf{\$2,060}$$

3. Now, let's say Andrea decides to leave her money in the bank for three years.

A. What is the term of Andrea's certificate of deposit?

Three years

B. Fill in the table to find out how Andrea's investment grows.

	Beginning Balance	3% Interest	Ending Balance
Year 1	\$2,000.00	\$60.00	\$2,060.00
Year 2	\$2,060.00	\$61.80	\$2,121.80
Year 3	\$2,121.80	\$63.65	\$2,185.45



Introduction to Earning Interest: APR, APY and Compound Interest

Annual vs. Quarterly Interest

3. Andrea wants to invest **\$2,000** at her bank. She decides to open a statement savings account, which compounds quarterly, instead of an annual certificate of deposit. This statement savings account will pay her a **3% APR**. (Remember, 3% is 0.03 when written as a decimal.)

A. How often does Andrea's account compound?

Quarterly—four times

B. What will Andrea's 1st quarter interest payment be?

$$\text{Interest} = \frac{2000 \times 0.03}{4} = \frac{60}{4} = \mathbf{\$15}$$

C. What will Andrea's balance be when the year is over?

	Beginning Balance	3% Interest	Ending Balance
1st quarter	\$2,000.00	\$15.00	\$2,015.00
2nd quarter	\$2,015.00	\$15.11	\$2,030.11
3rd quarter	\$2,030.11	\$15.23	\$2,045.34
4th quarter	\$2,045.34	\$15.34	\$2,060.68

D. What APY will Andrea's statement savings account earn for the year?

$$\text{APY} = \frac{60.68}{2000} = 0.03034 = \mathbf{3.034\%}$$



Introduction to Earning Interest: APR, APY and Compound Interest

Quarterly vs. Monthly Interest

Andrea wants to invest **\$2,000** at her bank. She decides to open a money market savings account, which compounds monthly, instead of a statement savings account. This money market savings account will pay her a **3%** APR.

(Remember, 3% is 0.03 when written as a decimal.)

	Beginning Balance	3% Interest	Ending Balance
1st month	\$2,000.00	\$5.00	\$2,005.00
2nd month	\$2,005.00	\$5.01	\$2,010.01
3rd month	\$2,010.01	\$5.03	\$2,015.04
4th month	\$2,015.04	\$5.04	\$2,020.08
5th month	\$2,020.08	\$5.05	\$2,025.13
6th month	\$2,025.13	\$5.06	\$2,030.19
7th month	\$2,030.19	\$5.08	\$2,035.27
8th month	\$2,035.27	\$5.09	\$2,040.36
9th month	\$2,040.36	\$5.10	\$2,045.46
10th month	\$2,045.46	\$5.11	\$2,050.57
11th month	\$2,050.57	\$5.13	\$2,055.70
12th month	\$2,055.70	\$5.14	\$2,060.84

4. What APY will Andrea's money market savings account earn for the year?

$$\text{APY} = \frac{60.84}{2000} = 0.03042 = \mathbf{3.042\%}$$



Name _____

Date _____

Student Assessment

APR, APY AND COMPOUND INTEREST

Taylor has been saving her allowance and her babysitting money for years. She and her friend are planning to travel to Paris, France, when they have each saved enough money.

Taylor has saved **\$6,500** so far and her friend has saved almost as much. Taylor wants her money to work as hard for her as she has worked to save it!

Taylor's bank has three types of investments to choose from if she wants to put her money to work:

1. Annual certificate of deposit with a **3.5%** APR
2. Statement savings account with a **3.25%** APR
3. Money market savings account with a **3.0%** APR

Since Taylor and her friend have at least one more year before the big trip, which investment will help Taylor the most?

Annual CD (compounds annually)

Beginning Balance	Interest	Ending Balance
\$6,500.00		

Statement savings account (compounds quarterly)

	Beginning Balance	Interest	Ending Balance
1 st quarter	\$6,500.00		
2 nd quarter			
3 rd quarter			
4 th quarter			



Name _____	Date _____
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Money market savings account (compounds monthly)

	Beginning Balance	Interest	Ending Balance
1st month	\$6,500.00		
2nd month			
3rd month			
4th month			
5th month			
6th month			
7th month			
8th month			
9th month			
10th month			
11th month			
12th month			

What are the APYs of each investment? Complete the table.

Investment	APR	APY
Annual CD	3.50%	
Statement savings account	3.25%	
Money market savings account	3.00%	



Introduction to Earning Interest: APR, APY and Compound Interest

Student Assessment: Solutions

Taylor has been saving her allowance and her babysitting money for years. She and her friend are planning to travel to Paris, France, when they have each saved enough money.

Taylor has saved **\$6,500** so far and her friend has saved almost as much. Taylor wants her money to work as hard for her as she has worked to save it!

Taylor's bank has three types of investments to choose from if she wants to put her money to work:

1. Annual certificate of deposit with a **3.5%** APR
2. Statement savings account with a **3.25%** APR
3. Money market savings account with a **3.0%** APR

Since Taylor and her friend have at least one more year before the big trip, which investment will help Taylor the most?

Annual CD (compounds annually)

Beginning Balance	Interest	Ending Balance
\$6,500.00	\$227.50	\$6,727.50

Statement savings account (compounds quarterly)

	Beginning Balance	Interest	Ending Balance
1 st quarter	\$6,500.00	\$52.81	\$6,552.81
2 nd quarter	\$6,552.81	\$53.24	\$6,606.05
3 rd quarter	\$6,606.05	\$53.67	\$6,659.72
4 th quarter	\$6,659.72	\$54.11	\$6,713.83



Introduction to Earning Interest: APR, APY and Compound Interest

Money market savings account (compounds monthly)

	Beginning Balance	Interest	Ending Balance
1st month	\$6,500.00	\$16.25	\$6,516.25
2nd month	\$6,516.25	\$16.29	\$6,532.54
3rd month	\$6,532.54	\$16.33	\$6,548.87
4th month	\$6,548.87	\$16.37	\$6,565.24
5th month	\$6,565.24	\$16.41	\$6,581.65
6th month	\$6,581.65	\$16.45	\$6,598.10
7th month	\$6,598.10	\$16.50	\$6,614.60
8th month	\$6,614.60	\$16.54	\$6,631.14
9th month	\$6,631.14	\$16.58	\$6,647.72
10th month	\$6,647.72	\$16.62	\$6,664.34
11th month	\$6,664.34	\$16.66	\$6,681.00
12th month	\$6,681.00	\$16.70	\$6,697.70

What are the APYs of each investment? Complete the table.

Investment	APR	APY
Annual CD	3.50%	3.50%
Statement savings account	3.25%	3.29%
Money market savings account	3.00%	3.04%