

9th - 10th Grade Lesson Plan

Introduction to Earning 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, an existing **principal**.

Balance: the amount of money in a bank account.

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**, this is the **annual percentage rate (APR)**.

Example 1

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

- **Principal = \$8,000**
- **Term = 1 year**
- **APR = 2% (.02)**

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

$$\mathbf{\$8,000 \times .02 = \$160}$$

$$\mathbf{\$8,000 + \$160 = \$8,160}$$

- **VOCABULARY**

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

Compounding Period: the amount of time that elapses between **interest** payments.

Annual Compounding: once per year.

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% 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 **compounding annually**.

	Beginning Balance	2% Interest	Ending Balance
Year 1	\$8,000	\$160	\$8,160
Year 2	\$8,160	\$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**

The students will complete page one of the "Now You Try Student Worksheet."

- **QUARTERLY COMPOUNDING - STATEMENT SAVINGS ACCOUNT**

Quarterly Compounding: a type of **compounding period** in which **interest compounds** every three months.

- Jan - March 1st quarter
- April - June 2nd quarter
- July - Sept 3rd quarter
- Oct - Dec 4th quarter

Michael's bank offers other types of investment accounts in addition to **certificates of deposit (CD)**. One type of account is called a **statement savings account**. This type of account is similar to a **certificate of deposit (CD)** because 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 to leave the money in his account for a specific period of time. Michael can go into the bank and withdraw his money any time he wants. Also, instead of paying Michael his **interest** only once per year (**annually**), the bank will pay him the **interest** he has earned so far every **quarter**. **Statement savings accounts often compound quarterly**. Michael will receive an **interest** payment **deposit** into his account at the end of every **quarter**.

When that happens, the **interest** Michael earned in the previous **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**.

Example 3

Let's say Michael takes his **\$8,000** into 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 **certificate of deposit**. Michael's beginning **principal amount** is again **\$8,000** and his **APR** is still **2%**. However, Michael gets **interest compounded quarterly** on this account.

1. First, calculate his annual **interest**:

$$\mathbf{\$8,000 \times .02 = \$160}$$

2. Next, calculate what his 1st **quarter interest** payment will be:

$$\mathbf{\$160 / 4 = \$40}$$

3. Now add Michael's 1st **quarter interest** to his **principal balance**:

$$\mathbf{\$8,000 + \$40 = \$8,040}$$

- At the end of the 1st **quarter**, his **principal balance** will be **\$8,040**.

4. Now calculate the annual **interest** he will earn on **\$8,040**.

$$\mathbf{\$8,040 \times .02 = \$160.80}$$

5. Calculate his 2nd **quarter interest** payment:

$$\mathbf{\$160.80 / 4 = \$40.20}$$

6. Next, calculate Michael's new **principal balance**:

$$\mathbf{\$8,040 + \$40.20 = \$8,080.20}$$

- At the end of the 2nd **quarter** his **principal balance** will be **\$8,080.20**.

7. Next, calculate the **annual interest** he will earn on **\$8,080.20**:

$$\mathbf{\$8,080.20 \times .02 = \$161.60}$$

8. Calculate his **3rd quarter interest** payment:

$$\mathbf{\$161.60 / 4 = \$40.40}$$

9. Add Michael's **3rd quarter interest** payment to his **balance**:

$$\mathbf{\$8,080.20 + \$40.40 = \$8,120.60}$$

➤ At the end of the **3rd quarter** his **principal balance** will be: **\$8,120.60**

10. Finally, calculate the **annual interest** with a **balance** of **\$8,120.60**:

$$\mathbf{\$8,120.60 \times .02 = \$162.41}$$

11. Calculate his **4th quarter interest** payment:

$$\mathbf{\$162.41 / 4 = \$40.60}$$

12. Add his **4th quarter interest** payment to his **balance**:

$$\mathbf{\$8,120.60 + \$40.60 = \$8,161.20}$$

➤ At the end of the **4th quarter** his **principal balance** will be **\$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 a **certificate of deposit** instead? (**\$8,160**)

Let's compare these two choices. Which type of account would have earned Michael more **interest**?

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

Why? Both accounts were paying the same **2% APR**, why were the balances different at the end of the year?

If **2%** of **\$8,000** is **\$160**, and he earned **\$161.20** 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 money he earned, because of **compounding interest**, is called **annual percentage yield (APY)**.

- **VOCABULARY**

ANNUAL PERCENTAGE YIELD (APY): the actual rate your money earns taking compounding into consideration.

To **calculate the APY**, we divide the amount of interest he earned for the year by his original **principal deposit**.

$$\text{\$161.20} / \text{\$8,000} = .02015 = \text{2.015\%}.$$

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

- **NOW YOU TRY**

The students will complete page two of the “Now You Try Student Worksheet.”

- **COMPOUND INTEREST FORMULA**

As you can see, compounding several times per year and holding an investment for multiple years would make for a lot of manual calculations. Luckily, there is a formula called the **compound interest formula** that allows us to calculate the accumulated balance of an investment across multiple years and multiple compounding periods.

The teacher will introduce the compound interest formula below:

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

Where: A = Accumulated Balance

P = Principal

r = APR expressed as a decimal

n = number of compounding periods/year

t = number of years the investment lasts

Use the same example:

Let’s say Michael takes his **\\$8,000** into 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** and his **APR** is still **2%**. However, Michael gets **interest compounded quarterly** on this account.

Principal = \\$8,000
APR = 2% or .02
n = 4 (quarterly)
t = 1 year

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

$$A = \$8,000\left(1 + \frac{.02}{4}\right)^{4(1)}$$

$$A = \$8,000(1.005)^4$$

$$A = \$8,000(1.02015)$$


$$A = \$8,161.20$$

Compare the interest calculated using the formula with the interest calculated when we did the calculation “the long way” by hand. Notice the interest amounts match: \$161.20.

$$\text{Annual Percentage Yield (APY)} = \$161.20 / \$8,000 = .02015 = 2.015\%$$

- **NOW YOU TRY**

The students will complete page three of the “Now You Try Student Worksheet.”


$$\begin{aligned} A &= P\left(1 + \frac{r}{n}\right)^{nt} \\ A &= \$7,500\left(1 + \frac{.03}{4}\right)^{4(1)} \\ A &= \$7,500(1.0075)^4 \\ A &= \$7,500(1.030339) \\ A &= \$7,500(1.03034) \\ A &= \$7,727.55 \end{aligned}$$

- **MONTHLY COMPOUNDING - MONEY MARKET SAVINGS ACCOUNT**

Compounding Period: the amount of time that elapses between **interest** payments.

Monthly Compounding: when interest compounds once per month.

Michael’s bank offers another type of investment account called a **money market savings account**. This account works just like the statement savings account except the **compounding period** is **monthly** instead of **quarterly**.

Most money market savings accounts **compound monthly**. 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. Now Michael will begin **earning interest on his interest monthly!**

Example 4

This time, Michael takes his **\$8,000** into 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** and his **APR** is still **2%**. However, Michael gets **interest compounded monthly** on this account.

The 1st Quarter Interest Calculations

1. First, calculate his **annual interest**:

$$\mathbf{\$8,000 \times .02 = \$160}$$

2. Next, calculate what his **1st month's interest** payment will be:

$$\mathbf{\$160 / 12 = \$13.33}$$

3. Now add the **1st month's interest** to his **principal balance**:

$$\mathbf{\$13.33 + \$8,000 = \$8,013.33}$$

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

4. Next, calculate the **annual interest** he will earn on **\$8,013.33**:

$$\mathbf{\$8,013.33 \times .02 = \$160.27}$$

5. Calculate his **2nd month's interest** payment:

$$\mathbf{\$160.27 / 12 = \$13.36}$$

6. Now add his **2nd month's interest** to his **principal**:

$$\mathbf{\$13.36 + \$8,013.33 = \$8,026.69}$$

- At the end of the **2nd month** his **principal balance** will be **\$8,026.69**.

7. For the **3rd month**, calculate the **annual interest** he will earn on **\$8,026.69**:

$$\mathbf{\$8,026.69 \times .02 = \$160.53}$$

8. Next, calculate his **3rd month's interest** payment:

$$\mathbf{\$160.53 / 12 = \$13.38}$$

9. Add Michael's **3rd month's interest** to his **principal balance**:

$$\mathbf{\$13.38 + 8,026.69 = \$8,040.07}$$

- At the end of the **3rd month** his **principal balance** will be **\$8,040.07**.

10. 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**)

Calculations for all 12 months of the year:

	Beginning Balance	2% Interest	Ending Balance
1 st Month	\$8,000	\$13.33	\$8,013.33
2 nd Month	\$8,013.33	\$13.36	\$8,026.69
3 rd Month	\$8,026.69	\$13.38	\$8,040.07
4 th Month	\$8,040.07	\$13.40	\$8,053.47
5 th Month	\$8,053.47	\$13.42	\$8,066.89
6 th Month	\$8,066.89	\$13.44	\$8,080.33
7 th Month	\$8,080.33	\$13.47	\$8,093.80
8 th Month	\$8,093.80	\$13.49	\$8,107.29
9 th Month	\$8,107.29	\$13.51	\$8,120.80
10 th Month	\$8,120.80	\$13.53	\$8,134.33
11 th Month	\$8,134.33	\$13.56	\$8,147.89
12 th Month	\$8,147.89	\$13.58	\$8,161.47

Note: We rounded the monthly interest calculation *up* before we added each month's interest to the balance at the beginning of the month. There may be as much as a three cent difference at the end of the year when we calculate the interest using the formula. This three cent 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? (**.02018 or 2.018% APY**)

Now, let's try using the formula:

Principal = \$8,000
 APR = 2% or .02
 n = 12 (monthly)
 t = 1 year

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

$$A = \$8,000\left(1 + \frac{.02}{12}\right)^{12(1)}$$

$$A = \$8,000(1.001666)^{12}$$

$$A = \$8,000(1.02018)$$

$$A = \$8,161.44$$

$$APY = \frac{\$161.44}{\$8,000} = .02018 = 2.018APY$$

- NOW YOU TRY**

The students will complete page four of the "Now You Try Student Worksheet."

- **COMPARE ANNUAL, QUARTERLY AND MONTHLY COMPOUNDING**

Discussion:

1. If the **APR** is the same on all three investments, which is the best investment?
 - **The investment with the greatest number of compounding periods is the best investment.**
2. How do you think a bank might entice you to open **CDs** or **statement savings accounts** instead of always opening **money market accounts**?
 - A bank might entice a person to open **CDs** or **statement savings accounts** by offering a higher **APR** on products with less **compounding** periods.

Assessment/ Evaluation

- The teacher will assess the students' knowledge of **APR, APY, and compound interest** using the **9th - 10th Grade Assessment Worksheet**.