INTEREST AND BORROWING

BIG IDEAS:

- **Interest** is the amount of money a lender charges for lending money
- **Simple interest** is calculated only on the **principal** amount each **period**
- **Compound interest** is calculated on both the **principal** amount and the **interest that accumulates** each **period**

LEARNING GOALS AND SKILL DEVELOPMENT:
You know you have met the goals for this lesson when you can:

EMERGING

LEARNING GOALS	ANCHOR QUESTIONS
Explain the difference between simple and compound interest	3
Determine the simple interest paid on an amount borrowed over a specified period of time	4
Determine the compound interest paid on an amount borrowed over a specified period of time	5

SKILL BUILDING QUESTIONS			
1	2	3	4
5			

EVOLVING

LEARNING GOALS	ANCHOR QUESTIONS
Determine the amount of a simple interest investment given the principal and conditions of the investment	7
Determine the amount of a compound interest investment given the principal and conditions of the investment	8
Determine the impact of changing an interest rate for an investment	7, 8
Determine the impact of changing the interest type (simple or compound) for a loan	9

SKILL BUILDING QUESTIONS			
6	7	8	9
10			

EXTENDING

LEARNING GOALS	ANCHOR QUESTIONS
Determine how the compounding frequency affects the total interest paid for a loan	11
Determine the compound interest rate required to reach a financial goal in a given amount of time	13

SKILL BUILDING QUESTIONS			
11	12	13	14

BUILD YOUR SKILLS

1. Iyanu is going to purchase a new car that is priced at $24 500.

    a) Determine the cost of the car after a 13% sales tax is applied to the price.

    b) Iyanu plans to make a down payment of 20% of the cost (after tax) and finance the remaining balance. Determine the amount of the down payment.

    c) What would be some benefits of making a larger down payment in this situation?

2. The *20/10 rule* states the following:

    - Excluding housing debt (for example, mortgage payments), you should never borrow more than 20% of your annual net income.

    - Excluding housing payments (for example, mortgage payments), monthly debt payments should not exceed 10% of your monthly take-home pay.

    a) If your annual net income is $48 000, what is the maximum debt that you would allow yourself according to the 20/10 rule?

    b) If your monthly take-home pay is $6300, what is the maximum amount that you would allocate to monthly debt payments according to the 20/10 rule?

    c) If your monthly take-home pay is $5600, what is the maximum debt that you would allow yourself according to the 20/10 rule?

3. Explain the difference between *simple interest* and *compound interest*.

4. $1000 is borrowed with a simple interest rate of 5% per year.

    a) Copy and complete the table shown on the right.

    b) Is the relationship between time and the total owed linear or non-linear? Explain.

Time (years)	Total Owed ($)
0	
1	
2	
3	
4	
5	

5. $1000 is borrowed at an interest rate of 5% per year, compounded annually.

    a) Copy and complete the table shown on the right.

    b) Is the relationship between time and the total owed linear or non-linear? Explain.

6. Daniel is planning to use a mortgage to purchase a house. Describe how each of the following affects the amount of interest he must pay.

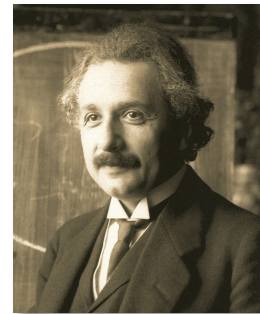   a) interest rate

    b) borrowing time

    c) down payment

7. $2500 is deposited into an account that pays simple interest at a rate of 3% per year.

    a) What will be the total amount in the account after 10 years?

    b) How much interest will be earned after 10 years?

    c) Would doubling the interest rate in this situation also double the interest earned after 10 years? Justify your answer.

8. $1200 is deposited into an account that pays interest at a rate of 2% per year, compounded annually

    a) What will be the total amount in the account after 10 years?

    b) How much interest will be earned after 10 years?

    c) Would doubling the interest rate in this situation also double the interest earned after 10 years? Justify your answer.

"Compound interest is the greaest mathematical discovery of all time."

9. Franco wishes to purchase a boat for $20 000. The seller has agreed to let Franco pay for the boat at a future date but will charge compound interest at a rate of 4.5%/month (compounded monthly) on any amount not paid up-front.

    a) How will a $3000 down payment affect the amount of interest Franco pays if he waits five months to pay off the balance?

    b) How would the answer for part (a) change if simple interest was used instead of compound interest?

10. Each of the following expressions was used to calculate the end value of a one-time deposit that gained interest annually over several years. In each case, state the type of interest used (simple or compound), the principal deposited, the annual interest rate as a percent, and the number of years over which the interest was earned.

    a) $A = 3500 + 3500(0.04)(15)$

    b) $A = 400(1.02)(1.02)(1.02)$

    c) $A = 30(1.014)^{20}$

    d) $A = 12(70)(0.026) + 70$

Interest and Borrowing

11. $10 000 is to be borrowed for three years at an interest rate of 6%/year.

    a) If the interest is compounded annually, how many compounding periods will occur?

    b) Determine the total amount owed if the interest is compounded annually.

    c) If the interest is compounded semi-annually, how many compounding periods will occur?

    d) If the interest is compounded semi-annually, what semi-annual interest rate would be used?

    e) Use your answers from parts (c) and (d) to determine the total amount owed if the interest is compounded semi-annually.

    f) Compare the interest owed with quarterly compounding to the interest owed with monthly compounding.

    g) In general, how does the compounding frequency affect the amount of interest accumulated?

12. Simona plans to borrow $9000 using a loan that charges interest at a rate of 2.3%/year, compounded annually.

    a) How much interest is charged for the 4th year of the loan?

    b) How much interest is charged for the 5th year of the loan?

    c) Are the answers for parts (a) and (b) the same? Why or why not?

    d) Would the answer for part (c) change if simple interest was being used? Explain.

13. Chung-Cha would like to deposit $1000 into an account and leave it there until it has doubled in value as a result of interest.

    a) If interest is compounded annually, what annual interest rate would allow her to reach her goal in 20 years?

    b) If interest is compounded annually, what annual compound interest rate would allow her to reach her goal in 10 years?

    c) Using the answers from parts (a) and (b), does it appear that doubling the compound interest rate results in exactly half the time being needed to reach the goal?

14. Loans are often paid off using a series of payments made at regular intervals (annually, monthly, bi-weekly, etc.). This type of payment schedule is called an *annuity*. Predict how the payment frequency (monthly, bi-weekly, etc.) would affect the total interest paid. Use an online loan calculator to check your prediction.

CHECK YOUR UNDERSTANDING

1. a) $27 685   b) $5537

c) Answers may vary. For example, interest is not paid on a down payment. A larger down payment means less money will be borrowed, resulting in less interest overall. A larger down payment may also make it easier to get approval for a loan and could result in lower monthly (weekly, bi-weekly, etc.) payments.

2. a) $9600   b) $630   c) $13 440

3. Simple interest is calculated only on the principal (starting) amount. The amount of interest is the same each period (year, month, week, etc.). Compound interest is calculated on both the principal amount and the interest that accumulates each period. The amount of interest increases each period.

4. a)

Time (years)	Total Owed ($)
0	1000.00
1	1050.00
2	1100.00
3	1150.00
4	1200.00
5	1250.00

b) Linear, since the total owed increases by the same amount each year ($50).

5. a)

Time (years)	Total Owed ($)
0	1000.00
1	1050.00
2	1102.50
3	1157.63
4	1215.51
5	1276.28

b) Non-linear, since the total owed increases by a different (greater) amount each year.

6. a) Higher interest rates will result in more interest paid.

b) A greater borrowing time will result in more interest paid.

c) A greater down payment will result in less interest paid.

7. a) $3250   b) $750

c) Yes, because simple interest is being used. If the interest rate is 6%/year, the interest earned in 10 years is $1500, which is double the interest earned with a rate of 3%/year.

ANSWERS

8. a) $1462.79   b) $262.79

   c) No, because compound interest is being used. If the interest rate is 4%/year, the interest earned in 10 years is $576.29, which is more than double the interest earned with a rate of 2%/year.

9. a) A $3000 down payment will reduce the interest paid by $3738.55.

   b) A $3000 down payment will reduce the interest paid by $675.00.

10.

	Type of Interest	Principal	Annual Interest Rate	Number of Years
a)	simple	$3500	4%	15
b)	compound	$400	2%	3
c)	compound	$30	1.4%	20
d)	simple	$70	2.6%	12

11. a) 3   b) $11 910.16   c) 6   d) 3%   e) $11 940.52

   f) $10.62 more interest is owed with monthly compounding than with quarterly compounding.

   g) Increasing the compounding frequency (compounding more often) results in more interest accumulated.

12. a) $221.61   b) $226.71

   c) No. Since compound interest is being used, the interest is calculated on a greater amount each year. Therefore, the amount of interest increases each year.

   d) Yes. Simple interest is only charged on the principal, so the same amount of interest would be charged each year.

13. a) 3.53%   b) 7.18%   c) no

14. As the payment frequency increases, the total interest paid decreases.

ANSWERS