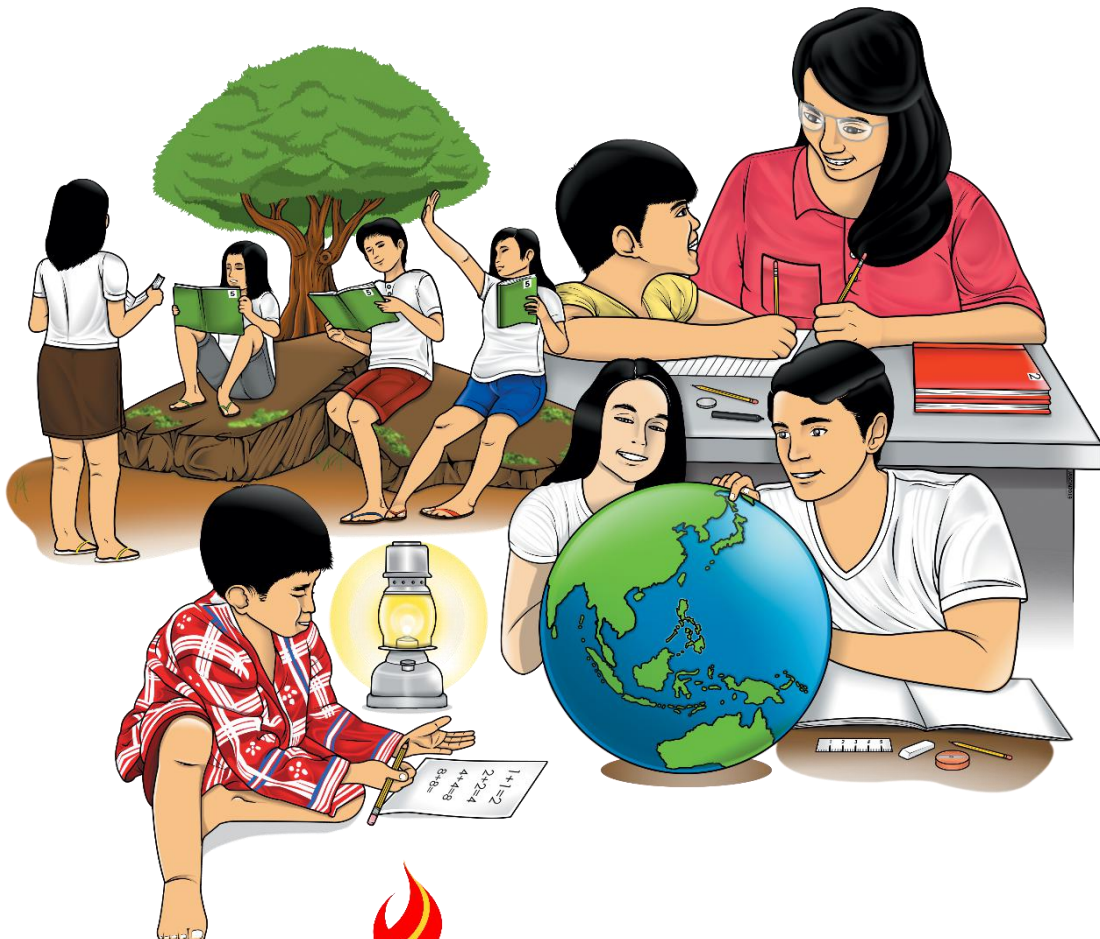


7

Mathematics

Quarter I - Module 4

Finding the Sum of the Terms of a Given Arithmetic Sequence



Mathematics – Grade 10
Alternative Delivery Mode
Quarter I – Module 4: Finding the Sum of the Terms of a Given Arithmetic Sequence
First Edition, 2020

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Mathematics

Quarter 1 - Module 4

Finds the Sum of the Terms of a Given Arithmetic Sequence

M10AL - Ic - 2

Introductory Message

This module was collaboratively designed, developed and reviewed by educators both from public and private institutions to assist you, the teacher or facilitator in helping the learners meet the standards set by the K to 12 Curriculum while overcoming their personal, social, and economic constraints in schooling.

This is a part of the fourth learning competency in our Mathematics 10 curriculum standard hence mastery of the skills is significant to have a smooth progress in the succeeding lessons.




For the facilitator:









Hi. As the facilitator of this module, kindly orient the learner on how to go about in reading and answering this learning material. Please be patient and encourage the learner to complete this module. Do not forget to remind the learner to use separate sheets in answering all the activities found in this module.

For the learner:

Hello learner. I hope you are ready to progress in your Grade 10 Mathematics by accomplishing this learning module. This is designed to provide you with interactive tasks to further develop the desired learning competencies on finding the sum of the terms of an arithmetic sequence. This module is especially crafted for you to be able to cope with the current lessons taken by your classmates. Please read completely the written texts and follow the instructions carefully so that you will be able to get the most of this learning material. We hope that you will enjoy learning.

Here is a guide on the parts of the learning modules which you need to understand as you progress in reading and analyzing its content.

ICON	LABEL	DETAIL
	What I need to know	This will give you an idea of the skills or competencies you are expected to learn in the module.
	What I know	This part includes an activity that aims to check what you already know about the lesson to take. If you get all the answers correct (100%), you may decide to skip this module.
	What's In	This is a brief drill or review to help you link the current lesson with the previous one.

	What's New	In this portion, the new lesson will be introduced to you in various ways such as a story, a song, a poem, a problem opener, an activity or a situation.
	What Is It	This section provides a brief discussion of the lesson. This aims to help you discover and understand new concepts and skills.
	What's More	This comprises activities for independent practice to solidify your understanding and skills of the topic. You may check the answers to the exercises using the Answer Key at the end of the module.
	What I have Learned	This includes questions or blank sentence/paragraph to be filled in to process what you learned from the lesson.
	What I Can Do	This section provides an activity which will help you transfer your new knowledge or skill into real life situations or concerns.
	Assessment	This is a task which aims to evaluate your level of mastery in achieving the learning competency.
	Additional Activities	In this portion, another activity will be given to you to enrich your knowledge or skill of the lesson learned. This also tends retention of learned concepts.
	Answer Key	This contains answers to all activities in the module.

At the end of this module you will also find:

References

This is a list of all sources used in developing this module.

The following are some reminders in using this module:

1. Use the module with care. Do not put unnecessary mark/s on any part of the module. Use a separate sheet of paper in answering the exercises.
2. Don't forget to answer *What I Know* before moving on to the other activities included in the module.
3. Read the instruction carefully before doing each task.
4. Observe honesty and integrity in doing the tasks and checking your answers.
5. Finish the task at hand before proceeding to the next.
6. Return this module to your teacher/facilitator once you are through with it.

If you encounter any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator. Always bear in mind that you are not alone.

We hope that though this material, you will experience meaningful learning and gain deep understanding of the relevant competencies. You can do it!

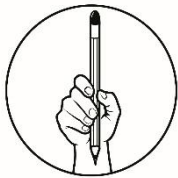


WHAT I NEED TO KNOW

This module was designed and written with you in mind. It is here to help you find the sum of the terms of an arithmetic sequence. The scope of this module permits it to be used in many different learning situations. The lessons are arranged to follow the standard sequence of the course but the pacing in which you read and answer this module will depend on your ability.

After going through this module, you are expected to be able to demonstrate knowledge and skill related to sequences and apply these in solving problems. Specifically, you should be able to:

- a) define arithmetic series,
- b) find the sum of the first n terms of a given arithmetic sequence, and
- c) solve word problems involving arithmetic series.



WHAT I KNOW

Find out how much you already know about the topics in this module. Choose the letter of the best answer. Take note of the items that you were not able to answer correctly and find the right answer as you go through this module. Write the chosen letter on a separate sheet of paper.

1. It is the sum of the terms of a sequence.
A) mean B) sequence C) n^{th} term D) series
2. Find the sum of the first ten terms of the arithmetic sequence 4, 10, 16, ...
A) 310 B) 430 C) 410 D) 390
3. Find the sum of the first 25 terms of the arithmetic sequence 17, 22, 27, 32, ...
A) 1925 B) 1195 C) 1655 D) 1895

4. The sum of the first 10 terms of an arithmetic sequence is 530. What is the first term if the last term is 80 and the common difference is 2.
 A) 64 B) 54 C) 34 D) 44
5. The third term of an arithmetic sequence is -12 and the seventh term is 8. What is the sum of the first 10 terms?
 A) 5 B) 8 C) 11 D) 15
6. Find the sum of the first 50 terms of the arithmetic sequence if the first term is 21 and the twentieth term is 154.
 A) 9635 B) 9765 C) 9265 D) 9625
7. Find the sum of the first eighteen terms of the arithmetic sequence whose n th term is $a_n = 15 + 8n$.
 A) 1438 B) 1638 C) 1836 D) 1783
8. The first term of an arithmetic sequence is 5, the last term is 45 and the sum is 275. Find the number of terms.
 A) 13 B) 10 C) 12 D) 11
9. If the first n terms of the arithmetic sequence 20, 18, 16,... are added, how many of these terms will be added to get a sum of -100 ?
 A) 35 B) 25 C) 15 D) 30
10. A yaya receives a starting annual salary of Php 36,000.00 with a yearly increase of Php 3,000.00. What is her total income for 8 years?
 A) Php 315,000.00 B) Php 372,000.00
 C) Php 432,000.00 D) Php 495,000.00
11. Jane was saving for a pair of shoes. From her weekly allowance, she was able to save Php 10.00 on the first week, Php 13.00 on the second, Php 16.00 on the third week, and so on. If she continued saving in this pattern and made 52 deposits, how much did Jane save?
 A) Php 3,984.00 B) Php 4,568.00
 C) Php 4,498.00 D) Php 5,678.00
12. Mary gets a starting monthly salary of Php 6,000.00 and an increase of Php 600.00 annually. How much income did she receive for the first three years?
 A) Php 276,300.00 B) Php 237, 600.00
 C) Php 637, 300.00 D) Php 673, 200.00

For example, how do we compute the sum of all the terms of each of the following sequences?

- a) 1, 2, 3, . . . , 100
- b) 5, 10, 15, 20, . . . , 50
- c) -5, -2, 1, 4, . . . , 31

Adding manually the terms of a sequence is manageable when there are only few terms in the sequence. However, if the sequence involves numerous terms, then it is no longer practical to be adding the terms manually. It is a tedious work to do. Thus, this module will present to you a formula that will make the computation easier and faster.



WHAT'S NEW

To let you experience getting the sum of the terms in a sequence manually, do the following.

1. Find the sum of the first 20 natural numbers.

Solution:

- a. By listing all the natural numbers from 1 to 20 and adding them, we have:

$$1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 + 10 + 11 + 12 + 13 + 14 + 15 + 16 \\ + 17 + 18 + 19 + 20 = 210$$

- b. Thus, the sum of the first 20 natural numbers is 210.

2. Find the sum of all the terms of the sequence: 5, 10, 15, 20, . . . , 50.

Solution:

- a. By listing all the terms of the sequence and adding them, we have:

$$5 + 10 + 15 + 20 + 25 + 30 + 35 + 40 + 45 + 50 = 275$$

- b. Thus, the sum of the terms of the sequence is 275.

3. Find the sum $-5, -2, 1, 4, \dots, 31$.

Solution:

a. By listing all the terms of the sequence and adding them, we have:

$$-5 + (-2) + 1 + 4 + 7 + 10 + 13 + 16 + 19 + 22 + 25 + 28 + 31 = 169$$

b. Thus, the sum of the terms of the sequence is 169.

In doing this kind of solution, it is very challenging specially if you are dealing with a sequence that has many terms. For example, finding the sum of the terms of the sequence: $1, 2, 3, \dots, 10,000$. There are 10,000 terms to be added one by one to get their sum.

To derive a formula to be used in finding the sum of the terms of an arithmetic sequence, consider the following illustration:

The terms of an arithmetic sequence with common difference, d , are

First term	a_1
Second term	$a_1 + d$
Third term	$a_1 + 2d$
Fourth term	$a_1 + 3d$
\vdots	\vdots
n^{th} term	$a_1 + (n - 1)d$

Thus, the sum of the terms, S_n , is:

$$S_n = \underbrace{a_1}_{1^{\text{st}}} + \underbrace{(a_1 + d)}_{2^{\text{nd}}} + \underbrace{(a_1 + 2d)}_{3^{\text{rd}}} + \underbrace{(a_1 + 3d)}_{4^{\text{th}}} + \dots + \underbrace{[a_1 + (n - 1)d]}_{n^{\text{th}}}$$

The terms of an arithmetic sequence can also be written starting from the n^{th} term and successively subtracting the common difference, d . Hence,

$$S_n = a_n + (a_n - d) + (a_n - 2d) + (a_n - 3d) + \dots + [a_n - (n - 1)d]$$

To find the rule for S_n , add the two equations:

$$\begin{array}{r} S_n = a_1 + (a_1 + d) + (a_1 + 2d) + (a_1 + 3d) + \dots + [a_1 + (n-1)d] \\ + S_n = a_n + (a_n - d) + (a_n - 2d) + (a_n - 3d) + \dots + [a_n - (n-1)d] \\ \hline 2S_n = (a_1 + a_n) + (a_1 + a_n) + (a_1 + a_n) + (a_1 + a_n) + \dots + (a_1 + a_n) \end{array}$$

Notice that all the terms containing d added out. So,

$$2S_n = n(a_1 + a_n)$$

Divide both sides of the equation by two,

$$S_n = \frac{n(a_1 + a_n)}{2}$$

Substituting $a_n = a_1 + (n-1)d$ to a_n , will lead to the following formula:

$$\begin{aligned} S_n &= \frac{n[a_1 + a_1 + (n-1)d]}{2} \\ S_n &= \frac{n[2a_1 + (n-1)d]}{2} \end{aligned}$$

Thus, the sum of the terms of an arithmetic sequence is

$$S_n = \frac{n}{2}[2a_1 + d(n-1)]$$

where: S_n is the sum of the first n terms
 a_1 is the first term
 d is the common difference



WHAT IS IT

In getting the sum of the terms of an arithmetic sequence. We will be using any of the following the formula:

$$1) \quad S_n = \frac{n}{2}(a_1 + a_n) \quad \text{if the first and last term are given}$$

$$2) \quad S_n = \frac{n}{2}[2a_1 + (n-1)d] \quad \text{if the last term is not given}$$

Example 1. Find the sum of the first 20 natural numbers.

Given:

$$a_1 = 1 \quad a_n = 20 \quad n = 20 \quad S_n = ?$$

Solution:

Since the last term is given, we used the following formula:

$$S_n = \frac{n}{2} (a_1 + a_n)$$

Substituting the given values in the formula:

$$S_{20} = \frac{20}{2} (1 + 20)$$

$$S_{20} = 10 (21)$$

$$S_{20} = 210$$

\therefore The sum of the first 20 natural numbers is 210.

Example 2. Find the sum of the first 16 terms of the arithmetic sequence:

8, 11, 14, 17, 20, ...

Given:

$$a_1 = 8 \quad n = 16 \quad d = 3 \quad S_{16} = ?$$

Solution:

The last term is not given, so we use the formula

$$S_n = \frac{n}{2} [2a_1 + (n-1)d]$$

By substituting the given values in the formula:

$$\begin{aligned}S_{16} &= \frac{16}{2} [2(8) + (16 - 1)3] \\&= 8 [16 + (15)3] \\&= 8(16 + 45) \\&= 8(61) \\S_{16} &= 488\end{aligned}$$

∴ The sum of the first 16 terms of the series is 488.

Example 3. If the first n terms of the sequence: 9, 12, 15, 18, ... are added, how many terms give a sum of 126?

Given: $a_1 = 9$ $S_n = 126$ $d = 3$ $n = ?$

Solution:

The last term is not given so we use the following formula

$$S_n = \frac{n}{2} [2a_1 + (n - 1)d]$$

Substituting the given:

$$126 = \frac{n}{2} [2(9) + (n - 1)3]$$

$$126 = \frac{n}{2} [18 + (3n - 3)]$$

$$252 = n [18 + 3n - 3]$$

$$252 = n [3n + 15]$$

$$252 = 3n^2 + 15n$$

$$\frac{0}{3} = \frac{3n^2 + 15n - 252}{3}$$

$$0 = n^2 + 5n - 84 \quad \text{by factoring}$$

$$(n + 12)(n - 7) = 0$$

$$(n + 12) = 0 \quad (n - 7) = 0$$

$$n = -12 \quad n = 7$$

Since the domain of a sequence is the set of positive integers, we reject $n = -12$. Hence, we only accept $n = 7$.

∴ The number of terms that will add up to 126 is 7.

Example 4. Find the sum of the integers between 1 and 70, and are divisible by 3.

$$\text{Given: } a_1 = 3 \qquad a_n = 69 \qquad d = 3 \qquad n = ? \qquad S_n = ?$$

Solution:

a) To solve for n , use the formula:

$$a_n = a_1 + (n - 1)d$$

Substitute the given values:

$$69 = 3 + (n - 1)3$$

$$69 = 3 + 3n - 3$$

$$69 = 3n$$

$$n = 23$$

b) Since we already solved n , we can now solve for S_n .

$$S_n = \frac{n}{2} [2a_1 + (n - 1)d]$$

$$S_{23} = \frac{23}{2} [2(3) + (23 - 1)3]$$

$$S_{23} = \frac{23}{2} [6 + (22)3]$$

$$S_{23} = \frac{23}{2} (6 + 66)$$

$$S_{23} = \frac{23}{2} (72)$$

$$S_{23} = 828$$

\therefore The sum of the integers from 1 to 70 that are divisible by 3 is 828.

Example 5. The sum of the first 15 terms of an arithmetic sequence is 765. If the first term is 23, what is the common difference?

$$\text{Given: } a_1 = 23 \qquad n = 15 \qquad S_{15} = 765 \qquad d = ?$$

Solution:

$$S_n = \frac{n}{2} [2a_1 + (n - 1)d]$$

$$S_{15} = \frac{15}{2} [2(23) + (15 - 1)d]$$

$$765 = \frac{15}{2} [46 + (14)d]$$

$$1530 = 15(46 + 14d)$$

$$1530 = 690 + 210d$$

$$210d = 1530 - 690$$

$$210d = 840$$

$$d = 4$$

∴ The common difference is 4.



WHAT'S MORE

After knowing all the needed concept in finding the sum of an arithmetic sequence. You are now ready to answer the following exercises:

A. Find the indicated partial sum of each arithmetic series.

- 1) The first 9 terms of $5 + 8 + 11 + \dots$
- 2) The first 30 terms of $1 + 3 + 5 + \dots$
- 3) The first 14 terms of $6 + 9 + 12 + \dots$
- 4) The first 25 terms of $5 + 8 + 11 + \dots$
- 5) The first 15 terms of $-12 + (-6) + 0 + \dots$

B. Solve for the value of n .

- | | | | |
|-----------------|-------------|--------------|---------|
| 1) $S_n = -80,$ | $a_1 = 10,$ | $a_n = -26,$ | $n = ?$ |
| 2) $S_n = 50,$ | $a_1 = 4,$ | $a_n = 16,$ | $n = ?$ |
| 3) $S_n = -15,$ | $a_1 = 12,$ | $d = -3,$ | $n = ?$ |
| 4) $S_n = 180,$ | $a_1 = 5,$ | $d = 5,$ | $n = ?$ |

C) Answer what is asked.

- 1) Find the sum of the first 13 terms of the sequence: $-3, -1, 1, 3, \dots$
- 2) Find the sum of the first 15 terms of the arithmetic sequence:
 $10, 15, 20, 25, \dots?$
- 3) Find the sum of the first 11 terms of the arithmetic sequence:
 $-4, 3, 10, 17, \dots?$
- 4) Find the sum of the first 19 terms of the arithmetic sequence:
 $9, 14, 19, 24, \dots?$
- 5) Find the sum of the integers from 8 and 35.
- 6) Find the sum of all even integers from 10 to 70.
- 7) Find the sum of all odd integers from 1 to 50.
- 8) Find the sum of the integers from 20 to 130 and are divisible by 5.
- 9) If the sum of the first 8 terms of an arithmetic sequence is 172 and its common difference is 3, what is the first term?
- 10) If the sum of the first 9 terms of an arithmetic sequence is 216 and its first term is 4, what is the common difference?



WHAT I HAVE LEARNED

To find the sum of the terms of an arithmetic sequence, you can use the following formulae:

A. If the first and last terms are given:

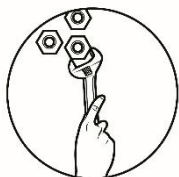
$$S_n = \frac{n}{2}(a_1 + a_n)$$

where: S_n is the sum of the first n terms
 a_1 is the first term
 a_n is the last term

B. If the last term is not given:

$$S_n = \frac{n}{2}[2a_1 + d(n - 1)]$$

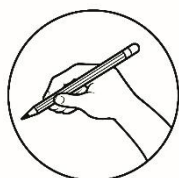
where: S_n is the sum of the first n terms
 a_1 is the first term
 d is the common difference



WHAT I CAN DO

Read and understand the problems and give what is asked.

1. Suppose a cinema has 42 rows of seats and there are 20 seats in the first row. Each row after the first row has two more seats than the row that it precedes. How many seats are in the cinema?
2. A 25-layer of logs is being piled to be used on a construction. The uppermost layer is composed of 25 logs, the second upper layer contains 27 logs, and the third upper layer contains 29 logs, and so on. If the pattern continues up to the lowest layer, what is the total number of logs piled for construction?



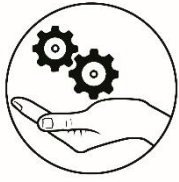
ASSESSMENT

Read and analyze each item carefully. Write the letter of the correct answer in a separate paper.

1. Which of the following is a formula for arithmetic series?

A) $S_n = \frac{1}{2}(a_1 + a_n)$ B) $S_n = \frac{n}{2}(a_1 + a_n)$ C) $S_n = \frac{1}{2}(a_1 + d)$ D) $S_n = \frac{n}{2}(a_1 + da_n)$

2. Find the sum of the first 12 terms of the arithmetic sequence 4, 11, 18, ...
 - A) 610
 - B) 530
 - C) 510
 - D) 410
3. Find the sum of the first 15 terms of the arithmetic sequence 17, 12, 7, 2, ...
 - A) 270
 - B) 287
 - C) -287
 - D) -270
4. The sum of the first 12 terms of an arithmetic sequence is 606. What is the first term if the last term is 67 and the common difference is 3.
 - A) 64
 - B) 54
 - C) 34
 - D) 44
5. The second term of an arithmetic sequence is -16 and the eighth term is 8. What is the sum of the first 10 terms?
 - A) -15
 - B) -20
 - C) 15
 - D) 20
6. Find the sum of the first 40 terms of the arithmetic sequence if the first term is 16 and the tenth term is 70.
 - A) 5320
 - B) 1720
 - C) 2200
 - D) 6320
7. Find the sum of the first 15th terms of the arithmetic sequence whose n th term is $a_n = 5 + 3n$.
 - A) 870
 - B) 860
 - C) 435
 - D) 430
8. The first term of an arithmetic sequence is 8, the last term is 56 and the sum is 416. Find the number of terms.
 - A) 13
 - B) 12
 - C) 11
 - D) 10
9. If the first n terms of the arithmetic sequence 24, 20, 16,... are added, how many of these terms will be added to get a sum of -60?
 - A) 35
 - B) 30
 - C) 25
 - D) 15
10. A yaya receives a starting annual salary of Php 60,000.00 with a yearly increase of Php 3,600.00. What is her total income for 5 years?
 - A) Php 672,000.00
 - B) Php 552,000.00
 - C) Php 276,000.00
 - D) Php 336,000.00



ADDITIONAL ACTIVITY

Let us sing the song titled “Twelve Days of Christmas.” Afterwards, answer the question that follows.

Verse 1:

On the first day of Christmas my true love sent to me

A partridge in a pear tree

Verse 2:

On the second day of Christmas my true love sent to me

Two turtle doves, and a partridge in a pear tree

Verse 3:

On the third day of Christmas my true love sent to me

Three French hens

Two turtle doves, and a partridge in a pear tree

Verse 4:

On the fourth day of Christmas my true love sent to me

Four calling birds

Three French hens

Two turtle doves, and a partridge in a pear tree

Verse 5:

On the fifth day of Christmas my true love sent to me

Five golden rings

Four calling birds

Three French hens

Two turtle doves, and a partridge in a pear tree

Verse 6:

On the sixth day of Christmas my true love sent to me

Six geese a – laying

Five golden rings

Four calling birds

Three French hens

Two turtle doves, and a partridge in a pear tree

Verse 7:

On the seventh day of Christmas my true love sent to me

Seven swans a - swimming

Six geese a - laying

Five golden rings

Four calling birds

Three French hens

Two turtle doves, and a partridge in a pear tree

Verse 8:

On the eighth day of Christmas my true love sent to me

Eight maids a-milking

Seven swans a - swimming

Six geese a - laying

Five golden rings

Four calling birds

Three French hens

Two turtle doves, and a partridge in a pear tree

Verse 9:

On the ninth day of Christmas my true love sent to me

Nine ladies dancing

Eight maids a-milking

Seven swans a - swimming

Six geese a - laying

Five golden rings

Four calling birds

Three French hens

Two turtle doves, and a partridge in a pear tree

Verse 10:

On the tenth day of Christmas my true love sent to me

10 lords a-leaping

Nine ladies dancing

Eight maids a-milking

Seven swans a - swimming

Six geese a - laying

Five golden rings

Four calling birds

Three French hens

Two turtle doves, and a partridge in a pear tree

Verse 11:

On the 11th day of Christmas my true love sent to me

11 pipers piping

10 lords a-leaping

Nine ladies dancing

Eight maids a-milking

Seven swans a - swimming

Six geese a - laying Five golden rings

Four calling birds

Three French hens

Two turtle doves, and a partridge in a pear tree

Verse 12:

On the 12th day of Christmas my true love sent to me

12 drummers drumming

11 pipers piping

10 lords a-leaping

Nine ladies dancing

Eight maids a-milking

Seven swans a - swimming

Six geese a - laying

Five golden rings

Four calling birds

Three French hens

Two turtle doves, and a partridge in a pear tree

Summarizing, we have the following:

12 drummers drumming

11 pipers piping

10 lords-a-leaping

9 ladies dancing

8 maids- a - milking

7 swans-a-swimming

6 geese - a - laying

5 golden rings

4 calling birds

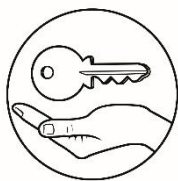
3 French hens

2 turtles doves, and

A partridge in a pear tree.

Question:

How many gifts are given after the 12th day of Christmas?



ANSWER KEY

		Additional Activity
What I Can Do Assessment	A. What's More	What I Know
	B.	
	C.	

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