10
Grade

(GCED)

Global Citizenship Education

Lesson Exemplar

MATHEMATICS

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Learning Area: Mathematics
Grade Level: 10
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Learning Area: Mathematics

Grade Level: 10

Quarter: 1st

GCED Domain/s: Cognitive, Socio-Emotional and Behavioral

GCED Indicator/s:

D.1.1.a. Recognize complex situations or problems

D.1.1.e Evaluate appropriate actions, consequences, and implications

D.2.1.e Commit to assume responsibility, mutual assistance, cooperation, and collaboration in various contexts in the world.

D.3.1.b. Initiate actions about local, national or global issues

GCED Topic/s:

T1.3. Interconnectedness of global, national and local systems

Enhanced Content Standard/s:

Demonstrates understanding of key concepts of sequences, polynomials and polynomial equations relevant to local, national, or global community.

Enhanced Performance Standard/s:

Is able to formulate and solve local, national, or global problems on climate change involving sequences, polynomials and polynomial equations in different disciplines through appropriate and accurate representations.

Time Allotment:

60-90 minutes

TABLE OF CONTENTS

ARITHMETHIC SEQUENCE AND ITS APPLICATION

LESSON INTRODUCTION

The earth is in danger, and everyone faces our greatest fear, the consequences of climate change. Floods, disease, and famine have led to unprecedented large-scale migration in already highly stressed areas; droughts and crop failures have led to increased competition for food, and water; wildlife is put to higher risks where animal and plant species are struggling to cope. Climate change affects all regions of the world and its impacts are to surge in the years to come.

To learn more about climate change particularly global warming, its causes and consequences, watch the video by following the link: https://www.youtube.com/watch?v=dcBXmj1nMTQ.

The documentary featured facts demonstrating that carbon dioxide is one of the most destructive greenhouse gases in the atmosphere, continuously raising the earth's temperature and causing global warming. Many experts believe that rising temperatures is caused by increased carbon dioxide levels in the atmosphere. The combustion of fossil fuels produces carbon dioxide as a byproduct.

World Trade Organization (WTO, 2010) reported, "The lack of business responsibility has led to growth without conscience: an unsustainable growth that is oblivious to what we have done to the environment and an excessive consumption culture disregarding its impact on future generations. The planet Earth can sustainably support a maximum of 430 to 450 parts per million (ppm) of CO2 in a given volume of air. We are already at 390 ppm and increasing at the rate of 2 ppm per year. If we do nothing, we will face a catastrophic calamity – which is only 20 to 30 years away – that will not distinguish between rich or poor, north or south, race or religion."

For you to gain a better picture and understanding of the impact of the Earth's CO2 profile on the climate crisis the world is experiencing today, the reported data can be translated and illustrated into an ARITHMETIC SEQUENCE.

This material provides you with activities that will help you learn all about arithmetic sequence. More than that, activities in this module will create awareness of the contributing factors of climate change, one of the most important issues our world is facing today.

LESSON OBJECTIVE

(WHAT I NEED TO KNOW / ALAMIN)

A. Cognitive

1.Recognize the problems and issues on climate change specifically on carbon dioxide emission;

2.Evaluate appropriate actions, consequences and implications of carbon dioxide composition;

3.Find the nthterm of an arithmetic sequence;

4.Illustrate arithmetic sequence depicted in carbon dioxide emission in the atmosphere ;

5.Formulate equation of arithmetic sequence on word problems related to climate change.

B. Socio-Emotional

6. Appreciate the use of arithmetic sequences in discoursing and addressing climate change issues on carbon dioxide emission;

7. Commit to assume responsibility, mutual assistance, cooperation, and collaboration in addressing climate change.

C. Behavioral

8.Take individual action to help address climate change by initiating carbon dioxide offsetting measures at household or community level.

PRETEST

(WHAT I NEED TO KNOW / SUBUKIN)

How well do you understand arithmetic sequences and their applications?

Part A

Directions: Choose the letter that corresponds to the answer of each item. Write your answer in a separate answer sheet.

1. What is the common difference in the arithmetic sequence 2,7,12,17, … ?
   a. 2 B.5 C.17 D.20

2. What is the 100thterm of the sequence of the given the sequence -10, -5, 0, 5, … ?
   a. 500 B. 485 C. 1005 D. 355

3. Which among the given situations DOES NOT illustrate an arithmetic sequence?

   a. Between 2009-2018, the growth rate of CO2 emission has been 2.3 ppm per year.
   b. There are numerous methods for increasing carbon in soils. Planting cover crops in fields that would otherwise be bare can extend photosynthesis throughout the year, sequestering approximately half a metric ton of CO2 per acre per year.
   c. The potential for carbon removal from the forests and trees outside of forests in the United States alone is more than a half gigatonne per year.
   d. The number of cases in the Philippines can be modelled by the equation an = 1 000(1.61n-1), where an is the number of COVID-19 infections after n months.

4. According to the most recent United Nations estimates elaborated by Worldometer, the current world population is 7.9 billion as of June 2021. What is the equation for calculating the projected population after n years if global human population growth is 75 million per year?
   a. an = 1 000(7.9n-1)
   b. an = 7.9 (n-1)75 000 000
   c. an =7900000000+(n-1)75000000
   d. an=75000000+(n-1)7.9

Direction: Answer the question.

How can understanding of arithmetic sequences help you to make an informed decision on mitigating the causes and consequences of climate change?

LESSON PROPER

REVIEW (WHAT'S IN/BALIKAN)

Before we get into the arithmetic sequence, we will test your knowledge of patterns and sequences.

A pattern in mathematics is a repeated arrangement of numbers, shapes, and colors and so on. The Pattern can be associated with any kind of event or object. Patterns can have a finite or infinite number of variations. A sequence is a set or chain of numbers that usually follows a particular pattern.

The scenarios and problems presented below address the activity's goal (PATTERNS and SEQUENCES).

Directions: Each item below shows a pattern. Write your answer in a separate sheet of paper.

1. A greenhouse gas (GHG or GhG) is a gas that absorbs and emits radiant energy due to the gravitational pull of the Earth. These gases are methane (CH4), nitrous oxide (N2O), argon (Ar) , carbon dioxide (CO2), and ozone (O3). What are the next three symbols in the following sequence?

CH4, N2O , Ar, CO2, O3, CH4, CH4,, N2O, N2O, Ar, Ar, CO2, CO2,O3 , O3 , , CH4, CH4,, ...

A. N2O, N2O, N2O, B. CH4, N2O , Ar C. , Ar, Ar, CO2 D. CH4, N2O, N2O

2. What is the next number in the sequence 0, 6, 12, 18, 24, ...?

A. 30 B. 36 C. 42 D. 48

LESSON PROPER

ACTIVITY (WHAT'S NEW/TUKLASIN)

Activity 1: Watch and Learn!

Directions:

Watch the video by following the link (32) WeatherMinds: New study shows carbon dioxide levels increasing - YouTube.

Take note of important details.

Answer the following questions to ponder.

1. What facts or important data related to climate change and global warming were discussed in the video?

2. Are these facts new to you? If not, when and from whom did you learn them?

Activity 2: Carbon Arithmetic

Directions:

Read the report given by World Trade Organization in one of their discussions during the public forum held in 2009 and answer the guide questions that follow to complete the table of values

> According to reports, the earth's carbon dioxide abundance is already at 390 ppm in a given volume of air in 2009 and is steadily increasing at a rate of 2ppm per year.

Year	2009	2010	2011	2012	2013	2014
CO_2 in ppm	390	?	?	?	?	?

LESSON PROPER

ACTIVITY (WHAT'S NEW/TUKLASIN)

Guide Questions:

1. Given that CO_2 are rising by 2ppm per year, what is the expected CO_2 per volume in 2010? What about 2011? What method did you use to solve it?

2. How much CO_2 was produced in 2014? What about in 2021?

3. How many parts per million (ppm) of CO_2 will be there in 100 years from year 2009?

4. How did you calculate the expected volume of CO_2 in the previous question?

We can calculate the volume of CO_2 in parts per million after a few years for you. Use the concepts of arithmetic sequence or arithmetic progression to solve it.

LESSON PROPER

DISCUSSION (WHAT IS IT/TALAKAYIN)

An arithmetic sequence, also known as arithmetic progression, is a sequence of numbers where the next term is obtained by getting the sum of the term and the common difference. The common difference of an arithmetic sequence is the difference of a term and the term immediately before it in the sequence.

Example A

Based on the previous activity, the CO2 sequence in ppm is 390, 392, 394, 396, 398, 400, 402, 404 which is an arithmetic sequence with a common difference of 2.

The nth term (an) of an arithmetic sequence with a common difference(d) can be computed by

$$an = a1 + (n-1)d.$$

For this example, we have a1= 390, a2= 392, a3= 394, a4= 396, a5= 398, a6= 400, and so on.

1. CO2 abundance in 2009 is 390 ppm, how abundant is CO2 in 2019 using the increasing rate of 2ppm?

Solve: $an = a1 + (n-1)d$

Using the given, a1 = 390 and d= 2. Determine the value of n using the formula.

Since a1 starts at year 2009, and we are to solve for the year 2019, n is the number of years from 2009 to 2019. Hence n=11. Use the formula for an.

$$a11 = 390 + (11-1)2 \quad a11 = 392 + (10)2$$

$$a11 = 392 + 20$$

$$a11 = 412$$

LESSON PROPER

DISCUSSION (WHAT IS IT/TALAKAYIN)

Using the same situation in the previous item, what is a50 ?

Solve: an =a1 +(n–1)d

a50 =390+(50–1)2

a50 = 390 + (49)2

a50 =390+98

a50 = 488

Guide Questions:

1. Given that the planet Earth can sustainably support a maximum of 430 to 450 ppm of CO2 in the atmosphere and based on your computed value for the 50th year beginning in 2009, what can you say about the difference of the computed value and the maximum parts per million of CO2 that Earth could support?

2. What can you do to minimize the increase of CO2?

Example B

Find the 16th term of the arithmetic sequence 12, 18, 24, 30, 36, ...

Solution:

Given: a1 =13 , d=31–25=6, n=16 and use the equation an =a1 +(n–1)d

a16 =13+(16–1)6 = 13 + 15(6)

= 103

The 16thterm of the sequence is 103.

LESSON PROPER

GENERALIZATION (WHAT I HAVE LEARNED/ISAISIP)

A. Answer the following to summarize what you have learned from this module.

1. How has the concept of arithmetic sequence helped you in comprehending the trend of carbon dioxide abundance in the coming years?

2. What can each individual do to help reduce CO2 emissions?

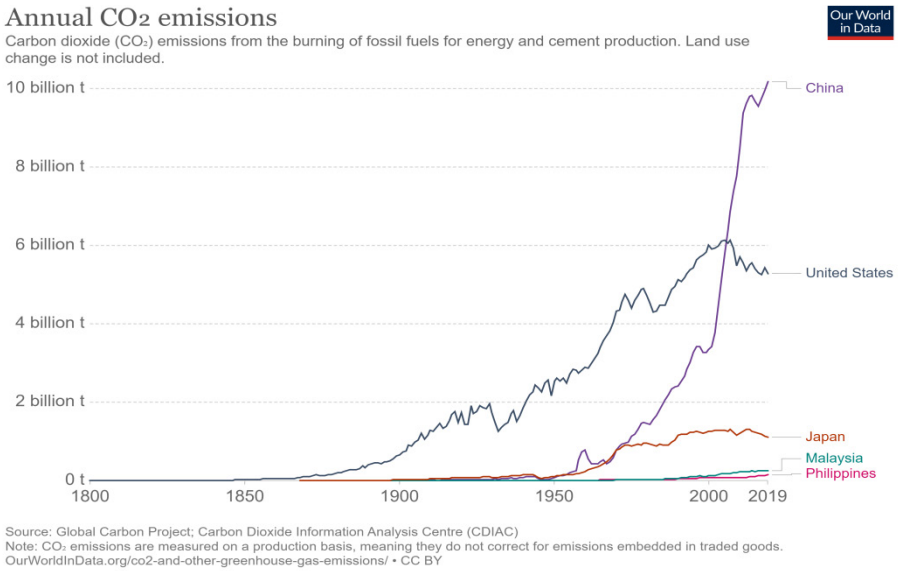
3. How significant is the understanding of arithmetic sequence in solving real-world problems on climate change?

4. Provide an example of real-world problem that can be modeled by arithmetic sequence.

LESSON PROPER

REFLECTION (WHY IS IT MEANINGFUL AND RELEVANT/ISAPUSO)

Directions: Based on the graph and data provided, answer the guide questions that follow.



Guide Questions for Reflection:

1. What is CO2 and how does abundance of its emission affect us and the world?
2. What can you say about the trend of CO2 emissions by five countries?

3. What do you think are the factors that cause the difference in CO2 for every country?

4. What other global pressing issues are likely associated with the rapid increase in CO2 emission?

5. There is a passage that says, “humanity needs more than Earth could offer.” In relation to CO2, what could humanity do to save the earth from the harmful consequences of increasing CO2 emissions?

LESSON PROPER

APPLICATION (WHAT I CAN DO/ISAGAWA)

Each year, the average Filipino consumer adds 1.22 tons of carbon dioxide to the atmosphere (https://www.worldometers.info/co2-emissions/philippines-co2-emissions/). A total of 126 922 662 tons of carbon dioxide was produced by the country in 2016. It came mainly from our food, transportation, and homes. In addition, Philippine Statistics Office reports that our country's population at year 2016 was 103 663 816 and it is continually rising at an average rate of 1.21% per year according to the data from Philippine Statistics Authority.

Directions: Using the above information, fill in the table with computed values and answer the follow-up questions.

Year	Population (P) Use 1.21% average increase of population	Average CO_2 footprint per capita in (tons/capita)	Population X CO_2 footprint per capita	Change
2016	103 663 816	Baseline	126 922 662	Baseline
2017	(1) _____	1.22 tons/capita	(2) _____	(3) _____
2018	(4) _____	1.22 tons/capita	(5) _____	(6) _____
2019	(7) _____	1.22 tons/capita	(8) _____	(9) _____

Questions to ponder:

1. What is the difference between the population in Year 2018 and Year 2017? How about in year 2019 and 2018?

2. Can we consider the progression of population in the Philippines as an arithmetic sequence? Why?

3. Using the given data, what do you think is the projected population of 2021?

4. What is the total CO2 emission produced by Philippines in 2021?

5. What do you think you could do as a Filipino and as a citizen of the world to reduce your CO2 contribution to the Earth's atmosphere

ASSESSMENT

TAYAHIN

You are now going to take your final assessment to see how much you have learned in this module.

Part A

Directions: Choose the letter that corresponds to the correct answer.

1. Find the 10th term of the arithmetic sequence given that a1 = 4 and d= 7 .

a. 67 b. 28 c. 96 d. 85

2. If a1 = 3 and d= -3, what is the 7th term?

a. -9 b. -15 c. 35 d. 15

3. Solve the 20th term of the sequence -2, 6, 14, 22, 30, ...

a. 158 b. 162 c. -100 d. 150

4. What should be the value of x so that x+2, 3x-2, 7x-12 will form an arithmetic sequence?

a. 6 b. 4 c. 2 d. 3

5. Which among the given situations DOES NOT illustrate an arithmetic sequence?

a. In the Philippines, the number of cases can be modeled by the equation an = 1 000(1.61n-1), where an is the number of COVID-19 infections after n months.

b. There are many ways to increase carbon in soils. Planting cover crops when fields are otherwise bare can extend photosynthesis throughout the year, sequestering about half a metric ton of CO2 per acre per year.

c. Carbon-removal potential from forests and trees outside forests in the United States alone is more than half a gigaton per year

d. Between 2009 -2018, the growth rate of CO2 emission has been 2.3 ppm per year.

Part B. Performance Task

According to Tree Nation publication in January 2020, planting six trees per month is enough to compensate for the CO2 emissions we produce. Using this information, formulate a household CO2 reduction or offset plan that you would propose to your family in response to the call to save the earth from the hazardous effects of climate change. Use the attached template for your output and note that it will be graded using the following rubric.

ASSESSMENT

TAYAHIN

Rubric for Rating

Score	Descriptor
4	The written plan which includes computations involving arithmetic sequence are completely accurate. Responses to the questions are very clear, highly relevant and reflective.
3	The written plan includes computations involving arithmetic sequence are with 1 to 2 mistakes. Responses to the questions are clear, relevant and reflective.
2	The written plan includes computations involving arithmetic sequence are with 3 to 4 mistakes. Responses to the questions are with minimal inconsistencies, less relevant and reflective.
1	The written plan includes computations involving arithmetic sequence are with more than 4 mistakes. Responses to the questions are unclear, impossible to follow, superficial and with so much inconsistencies.
0	No written report was made.

Household CO_2 Offset Plan

Family Name: _____ Address: _____

Number of household members: _____ Number of trees per month per member: _____

Number of trees to be planted for the whole household per month: _____

Example: if there are three household members, then each month, the family is to plant 3 x6 =18 trees.

Directions: Fill in each cell of the table and provide response to the questions. You can ask help from other family members in accomplishing the plan.

Month (please indicate the month)	Starting Month _____									
Total number of trees planted										

How would you convince your family to support you in executing your plan?	
How are you going to initiate this plan?	
What do you think is/are the hindering factor(s) that you and your family will experience in accomplishing the plan?	
What could you possibly do to overcome the challenges?	
If majority of the household will do the same, what difference could it bring in resolving climate change?	
Rate the possibility that your household could make this plan into action. (Rate 1-5, one as very small possibility and 5 for very high possibility)	

ANSWER KEY

SUSI SA PAGWAWASTO

Pretest (What I Need/Subukin)

Part A.

1. B
2. B
3. D
4. C

Part B Answers may vary

Review (What's In/Balikan)

1. D 2. A

Activity (What's New/Tuklasin)

Year	2009	2010	2011	2012	2013	2014
CO2 in ppm	390	392	394	396	398	340

Answers for Guide Questions:

1. 392 ppm, 394 ppm. Simply by adding 2pmm from the previous year.
2. 340 ppm. 414 ppm.
3. 100 years from now, or 100 years from 2021 is 112 years from 2009, so 614ppm.
4. answers may vary

Discussion (What Is It/Talakayin)

Answers to Guide Questions

1. answers may vary
2. answers may vary

Generalization

1-4 Answer may vary

Reflection (Why Is It Meaningful and Relevant/Isapuso)

Answer may vary.

Application (What I Can Do/Isagawa)

1. 104 918 148
2. 128 000 140.8
3. 1077478.772
4. 106 187 658
5. 129 548 942.5
6. 1548801.703
7. 107 472 528
8. 131 116 484.7
9. 1567542.204

Answers to Questions to Ponder

1. 1269509.59, 1284870.66
2. No, the differences are not equal.
3. 134308700.4
4. Answer may vary

Assessment/Tayahin

Part A

1. A 2. B 3. D 4. D 5.A

Part B -Answer may vary

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