Session Guide: Spread of Diseases

Session Outline

Description

This session introduces the concept of exponential growth in two contexts, a financial situation and on the spread of diseases. It presents learners with opportunities to compare exponential growth with other types of growth and provides opportunities for reflection of these in the different contexts. It has a stronger focus on the spread of disease and provides a very simplistic model on how mitigating strategies can reduce the rate of contagion of a communicable disease. It aims to deepen the learners' understanding of the importance of such strategies and is not to be considered an advisory lesson in any way.

Session Objectives

The objectives of this session are to:

- Understand the concept of exponential growth.
- Be able to recognise exponential growth compared to other types of growth.
- Distinguish between situations where exponential growth can be beneficial and detrimental.
- Understand the importance of mitigating strategies to reduce the rate of spread of a disease.
- Reflect on how their learning relates to their personal lives.

Expected Outcomes

By the end of the session learners will have:

- Explored exponential growth in a financial context and in the context of the spread of a disease.
- Carried out investigations with different bases of exponential growth to analyse their outcomes.
- Reflected on how factors can affect exponential growth to the point of making it non-exponential.
- Considered their personal circumstances and how they relate to these concepts.

Areas involved

- Mathematics and Financial Literacy
    - Ratios and Proportions
    - Expressions and Equations
    - Self-discovery
- Environment
    - Personal hygiene
    - (Non)Communicable Diseases
- Home science
    - Personal hygiene

Activity: Understanding Exponential Growth

Objectives

- To understand the concept of exponential growth.

Expected Outcomes

- Learners will have analysed three different types of growth and compared linear growth with two cases of exponential growth.

Teaching Instructions

Present the following imaginary scenarios to learners. Learners should make a quick decision about which one they would prefer and share it with the group, perhaps through a show of hands.

Split the group into teams of 3 or 4 and allow them to discuss which one they would prefer and why. Ask learners to consider how long they think they might live and how much they expect to get in 20 years and in 50 years as a guide for their discussion. Groups then present to the rest their choice and justify their reasons.

- Scenario 1: You are given KES 1 million this year, KES 2 million next year, KES 3 million the year after and so on, so that every year you are given KES 1 million more than the previous year.
- Scenario 2: You are given KES 1,000 this year but every year that passes you are given double of what you received the previous year.

- Scenario 3: You are given only KES 1 this year but every year that passes you are given three times as much as you received the previous year.

You can mention that scenarios 2 and 3 are cases of exponential growth while scenario 1 is a case of linear growth. Exponential growth might seem initially small but compounds to grow incredibly fast.

Student Instructions

Consider the following scenarios:

- Scenario 1: You are given KES 1 million this year, KES 2 million next year, KES 3 million the year after and so on, so that every year you are given KES 1 million more than the previous year.
- Scenario 2: You are given KES 1,000 this year but every year that passes you are given double of what you received the previous year.
- Scenario 3: You are given only KES 1 this year but every year that passes you are given three times as much as you received the previous year.

Which one do you think you would prefer instinctively?
Now think about how long you might live. How much would you receive in 20 years? How about 50 years? Was your initial instinct correct or would you prefer to choose a different one?

Activity: Exponential Spread of Diseases

Objectives

- To understand exponential growth in the context of the spread of a disease.

Expected Outcomes

- Learners will have explored the potential exponential spread of communicable diseases.

Teaching Instructions

Now present a different scenario: A city has a population of 350,000. One person contracts a communicable disease which spreads in such a way that every person who has it will pass it on to 2 people.
Lead a discussion about this scenario. How would they describe this disease, highly contagious or not very contagious? Will all the population get it? Is this model for the spread of disease a good one or are there any limitations (limitations can include people who already have or recovered from the disease, making the spread of 2 new people for each person who contracts it unrealistic for example).

Suggested Guidelines

- The discussion can start with you posing an initial question, let learners think about it individually, then discuss in groups of 2 or 3 and then share with the rest of the group to see if there are agreements or disagreements. Then pose a second question and repeat.

Student Instructions

Consider the following scenario: A city has a population of 350,000. One person contracts a communicable disease which spreads in such a way that every person who has it will pass it on to 2 people.
Consider the following questions:

- How would they describe this disease, highly contagious or not very contagious? Will all the population get it?
- Is this a realistic way to describe or quantify the spread of disease a good one or are there any limitations?

Activity: Introducing Limitations

Objectives

- To understand the importance of mitigating strategies to reduce the rate of spread of a disease.

Expected Outcomes

- Learners will have carried out an investigation on how mitigating strategies can drastically reduce the spread of a disease.
- Learners will have compared the impact of lowering the spread of a disease.

Teaching Instructions

Present learners with the following 2 scenarios:

- The disease is now such that each person who contracts the disease spreads it to an average of 1.5 people (which technically means that for every 3 people that come in contact with an infected person, 2 of them contract the disease).
- The disease is now such that each person who contracts the disease spreads it to only 1 more person.

Split the group into teams of 3 or 4 and pose the question of how contagious these scenarios are compared to the original one. Will everyone in the population get the disease? If it takes 1 day for the infected person to pass the disease on, how long will it take for the entire population to contract the disease? Groups should then share their findings and discuss how different the scenarios are.
Lead a brainstorming session on what can be done to prevent the spread of communicable diseases. What can be done to reduce the spread of a disease? Allow the group to identify methods to reduce the spread of diseases (quarantining, travel restrictions, social distancing, hygiene and hand washing, face masks, etc). If each method reduces the spread from 2 by 0.2, what impact could this have on the spread of the disease? Provide time for learners to consider how much they could lower the spread and what impact it will have, and let them discuss their conclusions.

Student Instructions

Consider the following two alternative scenarios:

- The disease is now such that each person who contracts the disease spreads it to an average of 1.5 people (which technically means that for every 3 people that come in contact with a diseased person, 2 of them contract the disease).
- Now, the disease is such that each person who contracts the disease spreads it to only 1 more person.

For each case, will everyone in the population get the disease? If it takes 1 day for the diseased person to pass the disease on, how long will it take for the entire population to contract the disease?
What methods do you know can reduce the spread of communicable diseases. If each method reduces the spread from 2 by 0.2, what impact could this have on the spread of the disease?

Activity: Covid-19 Reflection

Objectives

To be able to relate a mathematical model for the spread of diseases to the current situation with regards to Covid-19.

Expected Outcomes

Learners will have reflected on their personal actions and the current policies and understood the importance of following them to control the spread of Covid-19.

Teaching Instructions

Lead a reflective discussion around the following questions. We currently are living through a pandemic of a communicable disease. How do you think the concepts discussed relate to this? Does it help you understand the importance of having clear policies and practices to reduce the spread of Covid-19?
NOTE: This is not meant to be an advisory exercise nor is the model presented realistic. Make it clear to learners that the spread of Covid-19 has other factors that were not considered within this session and it is not a complete or accurate analysis. Make sure that learners are aware that the objective is to understand the importance of following specialists' and governmental policies to mitigate the spread of Covid-19, which include other more complex considerations in their definitions.