



Case Study 02

Basic data

Title of Research Teaching Unit	Exponential models
Unit created by	Istituto Comprensivo “Malaspina” – Massa (IT)
Based on Concept	Exponential models
Concept created by	Univerzita Karlova (CZ)
Date of teaching	26.01-2024
Number of students in class	20
Number of migrant students	1

1. Unit Description of Research Teaching Unit

Title	Exponential models
Age of students/grade	Grade 8
Length of the unit	2 hours
Mathematical topic	<ul style="list-style-type: none">Exponential functions – properties, graphs
Prerequisite knowledge	<ul style="list-style-type: none">Collecting, recording and analysing a data set number sequences and their propertiesGraphsCreating, reading and interpreting graphs (on the paper or using a computer)
Materials needed	<ul style="list-style-type: none">Descriptions of real-life situations: population growth, spread of diseases
Objectives	<ul style="list-style-type: none">Applying Mathematics in real-world problemsUsing IT tools in Mathematics (Geogebra, a spreadsheet)Improving students' ability to understand a scientific text, an article or a video with scientific contentDeveloping students' ability to collect, analyze and study a set of dataCooperating in groups
Notes on work with migrant students	<ul style="list-style-type: none">Dealing with specific vocabulary can enhance cooperation inside groups, some scientific concepts can be both international and comprehensible also for migrant students or they can be unknown also for home students.

Lesson plan

Lesson 1

In the previous year the class studied the topic “raising to power” and they are dealing now with functions: empirical functions, direct and indirect proportion

The teacher can start by proposing a manual activity to the class.

He/she can decide either to work in groups or to work with single students. It's about using an A4 sheet and dividing it into 3 parts. Then the students have to divide each obtained part into 3 other parts twice.

Afterwards the teacher will ask how many divisions they have made and how many sheets they have obtained, filling in a table like this one:

Number of divisions	0	1	2	3
Number of sheets				

At this point they will understand that this is a sequence about raising to the third power

$$\dots^0=1 \qquad \dots^1=3 \qquad \dots^2=9 \qquad \dots^3=27$$

Trying to infer the rule that implies that to each division of a sheet into 3 parts corresponds a certain number of sheets, they will discover an EXPONENTIAL FUNCTION, which will generally be written as:

$$y = a^x$$

where **a** is a number different from 0

At this point it will be possible (starting from the table already filled in empirically) by using Geogebra or drawing it on paper, to discover which kind of shape has this function, that will be very different from the functions they have seen so far.

About homework, the teacher can ask students to repeat this class experience changing the number of the divisions.

A sheet divided 4 times into 4 parts. Try to draw the graph after answering this question:

What is the rule which can let you determine the number of sheets you obtain after each division?

$$Y = 4^2$$

$$Y = 2 * 4$$

$$Y = 2^4$$

$$Y = 4 * 4$$

Lesson 2

The following lesson can deal with examples of exponential growth in nature, dealing with the spread of some illnesses, too.

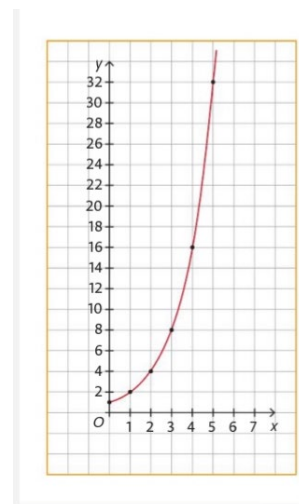
The class can go to the Science Lab where, if possible, they can start a bacterial seeding, which then will be observed in the following days and weeks through proper measurements and photographic evidence. (this can be done in groups)

Afterwards the teacher can show some videos about cell reproduction by binary fission (for example in bacteria or other unicellular organisms, as the students studied the cell and the living beings in the previous year). From the videos it will be really clear that the exponential growth leads to a very fast increasing number of cells.

(It is predictable that this will be obvious also from the experience about the bacterial seeding)

Starting from the videos they will be able to draw a table, get the formula and draw the graph, for example:

Number of cells after 0 fissions	1
Number of cells after 1 fission	2
Number of cells after 2 fissions	4
Number of cells after 3 fissions	8
Number of cells after 4 fissions	16
Number of cells after 5 fissions	32



The following task, at the end of the activity, can be the realization of a poster or a multimedia presentation, with the data collected by the students and if possible produced by multilingual groups, in order to promote exchanges ...

The teacher can also ask migrant students about personal experiences in their home country ...

2. Interview Analysis

The teacher teaching this unit has 12 years teaching experience. Her other subject is Science. She did not receive any training for teaching in multicultural classrooms neither in her initial nor in-service teacher training. In her prior teaching mathematics in these classrooms experience the most relevant issue she had encountered was related to migrant students who don't speak Italian. In this case, it is difficult even to understand if they understand what she is speaking about. Consequently, she tries to cooperate with a teacher specifically dedicated to support her in such circumstances. If this teacher is not available, she usually works creating peer to peer groups, because students of the same age can be more on familiar terms with their foreign classmates.

The advantages of having migrant students in the classroom are that there is something more which can be used in the lessons. You have to be more creative and to find new strategies for migrant students, but at the same time they have to be useful for the whole class. In addition, a multicultural class gives the students the chance to know more about different countries.

Some parts of the lesson plan were replaced by different activities:

We started a different activity from a simple example:

An uncle wants to give his nephews some monthly pocket money. He gives them 2 choices:

- 1) starting from 100 euros and every month adding 10 euros
- 2) Starting from 2 euros and every month doubling the sum.

So my students created the table and the following charts and they had to choose the best choice. Then, using some A3 sheets, we observed what happened to the paper thickness every time the sheet was folded in the middle. The measurements were made with the calibre and then we tried to describe the formula through which the paper thickness increased. At the end, we saw a short cartoon in English, where they could see how a paper sheet, through many foldings, could cover the distance Earth-Moon. Then we deduced the difference between "linear growth" and "exponential growth"

Some students thought about the spreading of illnesses, for example COVID-19.

List of materials replaced:

Original: Paper sheets Replaced by: paper sheets but also ruler and caliber, to measure the thickness.

3. Improvement Suggestions

Lesson plan is suitable in the current form (but always trying to pay attention to the composition of the class and the students' interests).