



Teaching unit

Title	Exponential models
Age of students/grade	Lower secondary students – 12/13 years
Length of the unit	Approximately 2 x 50 minutes (in addition to the recurring observations in the Science Lab.)
Materials needed	Descriptions of real-life situations: population growth, spread of diseases
Objectives	<ul style="list-style-type: none"> • applying Mathematics in real-world problems • using IT tools in Mathematics (Geogebra, a spreadsheet) • improving students' ability to understand a scientific text, an article or a video with scientific content • developing students' ability to collect, analyze and study a set of data • cooperating in groups
Content related anchor points	<ul style="list-style-type: none"> • exponential functions – properties, graphs • number sequences and their properties • collecting, recording and analysing a data set • creating, reading and interpreting graphs (on the paper or using a computer)
Methodology related anchor points	<ul style="list-style-type: none"> • suitable for working in groups • presentation of the results in front of the whole class • use of multimedia devices and tools • interdisciplinary work – possible cooperation with other teachers, for example Science teachers • use of tools in the Science Lab. (tools for the cultivation of bacterial colonies. microscope, videocamera)
Language related anchor points	<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. • basic knowledge of some concepts from Biology, Chemistry or use of scientific concepts. • scientific vocabulary

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 his/her 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

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

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 the 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?*

$$Y = 4^2 \qquad Y = 2 * 4 \qquad Y = 2^4 \qquad Y = 4 * 4$$

Lesson 2

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

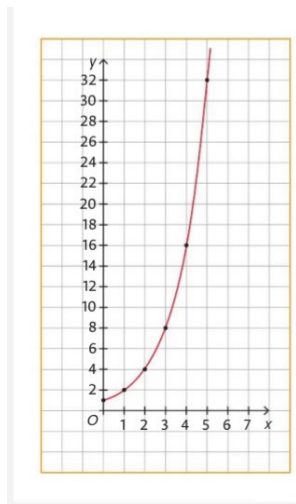
The class can go to the Science Lab where, if possible, they can start a bacterial seeding, which then will be observed in the following days and weeks through proper measurements and photographic evidence. (this can be done in groups)

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 his/her migrant students about personal experiences in their home country...