



## Case Study 02

### Basic data

|                                        |                                                      |
|----------------------------------------|------------------------------------------------------|
| <b>Title of Research Teaching Unit</b> | <b>Exponential models</b>                            |
| <b>Unit created by</b>                 | <b>Istituto Comprensivo “Malaspina” – Massa (IT)</b> |
| <b>Based on Concept</b>                | <b>Real-life exponential models</b>                  |
| <b>Concept created by</b>              | <b>Skola da Vinci (CZ)</b>                           |
| <b>Date of teaching</b>                | <b>26.01-2024</b>                                    |
| <b>Number of students in class</b>     | <b>20</b>                                            |
| <b>Number of migrant students</b>      | <b>1</b>                                             |

## 1. Unit Description of Research Teaching Unit

|                                            |                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Title</b>                               | <b>Exponential models</b>                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Age of students/grade</b>               | Grade 8                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Length of the unit</b>                  | 2 hours                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Mathematical topic</b>                  | <ul style="list-style-type: none"><li>Exponential functions – properties, graphs</li></ul>                                                                                                                                                                                                                                                                                                    |
| <b>Prerequisite knowledge</b>              | <ul style="list-style-type: none"><li>Collecting, recording and analysing a data set number sequences and their properties</li><li>Graphs</li><li>Creating, reading and interpreting graphs (on the paper or using a computer)</li></ul>                                                                                                                                                      |
| <b>Materials needed</b>                    | <ul style="list-style-type: none"><li>Descriptions of real-life situations: population growth, spread of diseases</li></ul>                                                                                                                                                                                                                                                                   |
| <b>Objectives</b>                          | <ul style="list-style-type: none"><li>Applying Mathematics in real-world problems</li><li>Using IT tools in Mathematics (Geogebra, a spreadsheet)</li><li>Improving students' ability to understand a scientific text, an article or a video with scientific content</li><li>Developing students' ability to collect, analyze and study a set of data</li><li>Cooperating in groups</li></ul> |
| <b>Notes on work with migrant students</b> | <ul style="list-style-type: none"><li>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.</li></ul>                                                                                                                        |

### 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.

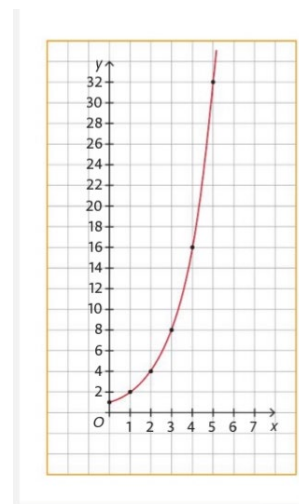
The class can go to the Science Lab where, if possible, they can start a bacterial seeding, which then will be observed in the following days and weeks through proper measurements and photographic evidence. (this can be done in groups)

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).

### **4. Classroom observation**

Students fairly participated in the lesson, especially in the first half of the activity and they cooperated in finding the solutions.

The working climate was positive but the teacher had to intervene in order to involve all students.

Compared to other teaching units, students and students cooperated more.

From a motivational point of view (attitude / interest / commitment), working in groups to solve real problems was suitable for all students, because peer tutoring helped the students in troubles.

From a cognitive point of view (increase in the level of learning), students enhanced the use of the formulas and their reasoning about problems.

From a cognitive point of view (increase in the level of learning), for some students it was necessary to remind the concept "raising to power" and how to create graphs and charts.

No evaluation test was administered.

The proposed teaching unit made it possible to carry out an effective recovery effort for students in difficulty, because working in groups led the students to overcome some difficulties in Maths, but also in text comprehension.

The teaching unit made it possible to carry out an effective stimulus action for the brightest students, because they were proud about sharing their ideas, being the spokesperson in their own group and in the final presentation of the work.

The main methodological choice and inclusion strategy used for pupils with a migratory background, it was to give them formularies with the translation of some words.