Pythagoras
2021-1-RO01-KA220-HED-000032258

MiniPBL PRESENTATION
STU in Bratislava, SLOVAKIA

SLOVAK UNIVERSITY OF TECHNOLOGY in BRATISLAVA, SLOVAKIA

INSTRUCTIONS FOR USE

MiniPBL is an Active Learning Method

Basis of this method is the independent work of students on small applied projects, often related to current environmental problems of the planet, which can be solved using some mathematical concepts and methods.

INSTRUCTIONS FOR USE

The main goal is to support the transfer of acquired mathematical knowledge to solving problems from the practice of the everyday life.

To show that MATHEMATICS is useful not only to pass exams and graduate from university, but rather as a magic tool suitable for modeling solutions of various problems in science, technology, art, or the current environmental crisis.

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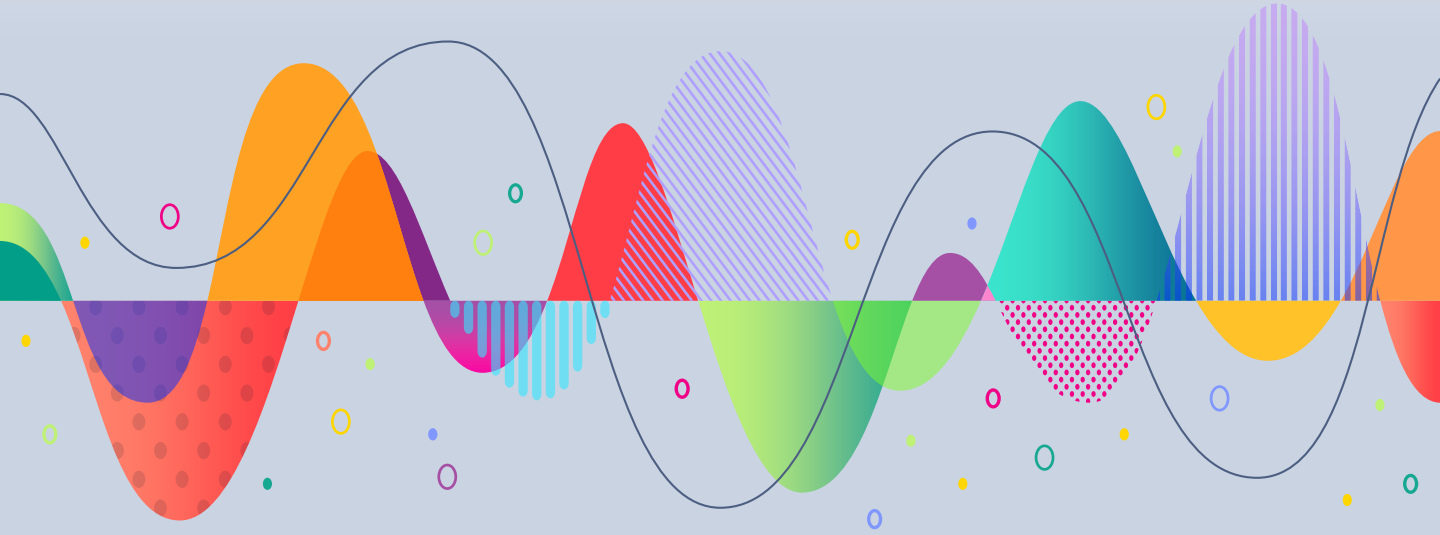
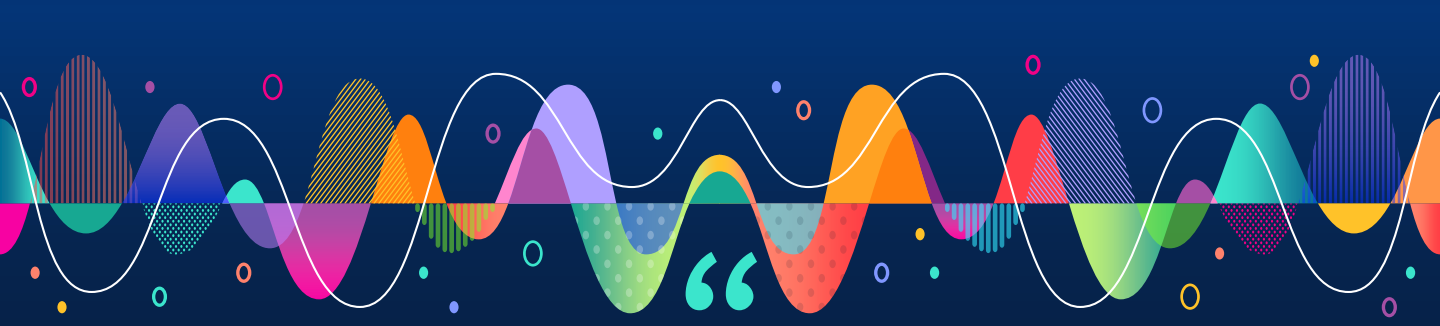
THE WATER POLLUTION

Let’s start with the problem description





The percentage of the polluted world ocean area is rapidly increasing every year.

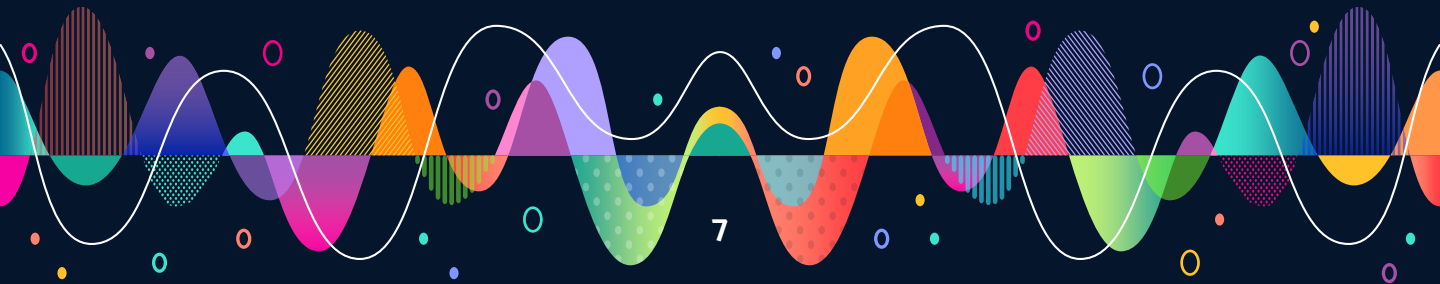
The latest findings of Canadian oceanographic scientists proved that in the ocean water one can find a higher portion of micro-plastics (**six times more**!) than is the amount of live plankton ...

The Buriganga River is a river in Bangladesh, which flows past the southwest outskirts of the capital city Dhaka.

Its average depth is 7.6 metres and its length is only 18 kilometres, but it is economically very important to Dhaka.

Launches and country boats provide connection to other parts of Bangladesh, a largely riverside country.

The river is also the source of drinking water.



POLLUTED RIVERS POLLUTE OCEANS

Buriganga is afflicted by the noisome problem of pollution, and it ranks among the most polluted rivers in the world.

More than 60 000 cubic metres of toxic chemical waste from mills and about 200 textile factories, household waste, medical waste, sewage, dead animals, plastics, and oil are some of the river most dangerous pollutants.

POLLUTED RIVERS POLLUTE OCEANS

The water of the Buriganga is now so polluted that all fish have died,
and increasing filth and human waste have turned it like a black gel.

Even walking on its banks or rowing across the river is now difficult for it smells so badly.

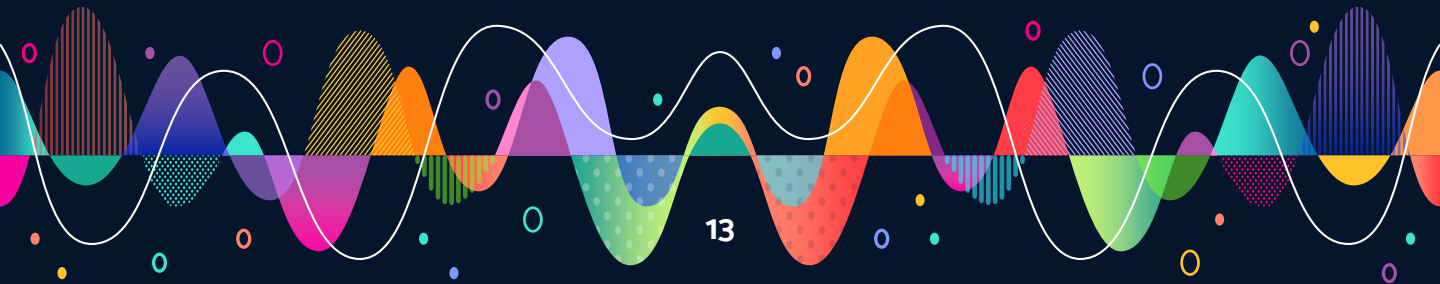
Buriganga River

This widespread problem of water pollution is jeopardizing our health.
Unsafe water kills more people each year than war and all other forms of violence combined.
Meanwhile, our drinkable water sources are limited, as less than 1% of the earth's freshwater is accessible.
Without action, the challenges will only increase by 2050, when global demand for freshwater is expected to be one-third greater than it is now.

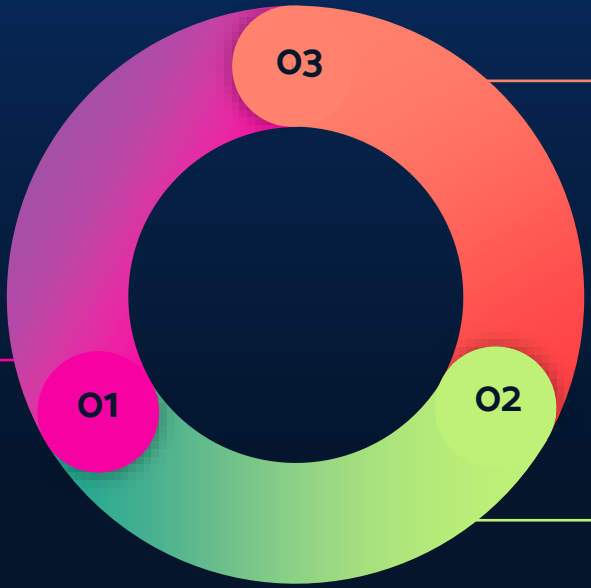
MAIN POLLUTANTS

Consider the percentage of the planet polluted water resources to be 20 at the time $t = 0$.

What would be the situation in the following years, under the current circumstances, when the process of water pollution is accelerated by one tenth of the pollution speed starting at value 1?



YOUR TASK IS EASY



Solve the problem in a teamwork

Read carefully your project sheet to understand the problem

Study suggested mathematical model and tasks to be solved

ROADMAP TO FIND MATHEMATICAL MODEL

1. Water pollution is represented as function of time $f(t)$

2. Value $f(0) = 20$ represents the percentage of the actual water pollution

3. Derivative $f'(t)$ represents the speed of the pollution process

4. Value $f'(0) = 1$ represents the current speed of the pollution

5. Second derivative $f''(t)$ represents the acceleration of the water pollution

6. $f''(t) = \frac{1}{10} f'(t)$ Mathematical model differential equation

FUNNEL

Sketch integral curves affected by adopted measures

How to stop pollution in 10 years?

Estimate time of complete water pollution

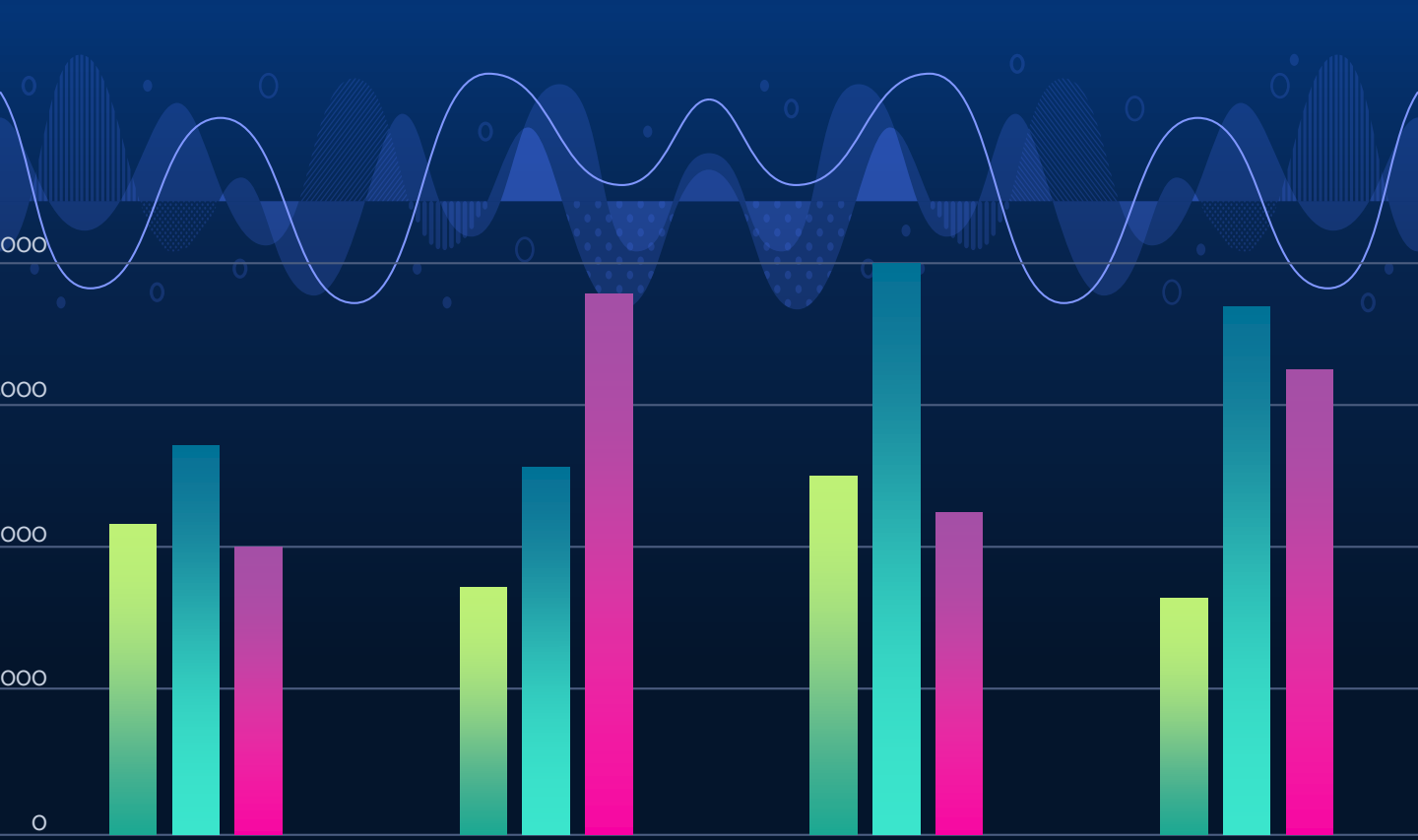
Sketch integral curves of pollution spread

Calculate pollution growth

Fing general solutions

Adopting ecological measures that might result in reduction of the water pollution process only by half, quite visible and remarkable improvements can be achieved in few coming years.

TASK 8 - SUGGEST YOUR ORIGINAL SOLUTIONS



Be ready to present your results

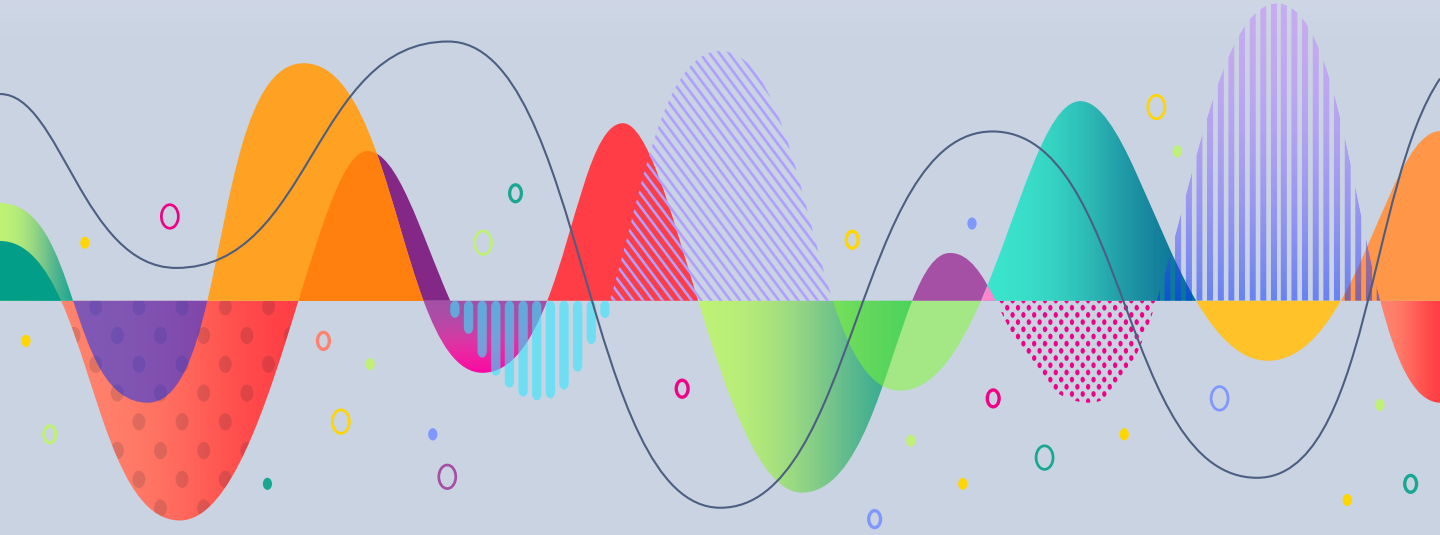
EXTRA RESOURCES

Find ideas on-line, or invent your own ones!

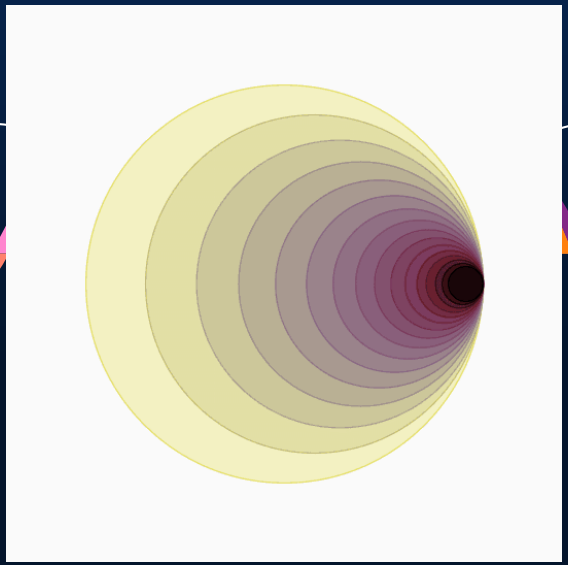
https://www.nrdc.org/stories/water-pollution-everything-you-need-know#whatis

https://www.geogebra.org/calculator

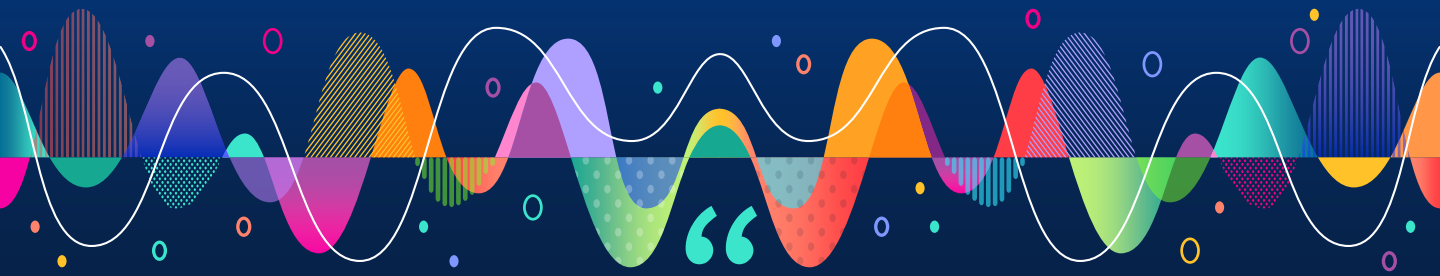
https://student.desmos.com/?lang=es



LET´S START!



Any questions?



$$y''(t) - \frac{1}{10}y'(t) = 0$$

$$\frac{d^2f(t)}{dt^2} - \frac{1}{10}\frac{df(t)}{dt} = 0$$