Science communication in secondary schools through limnology

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- ***Why science communication ?***
  - *Increase scientific competence of youngsters.*
  - *Foster citizen science*
- *Why physical limnology ?*
- *Why Secondary Schools ?*
- *How to communicate*
- *When and who*

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  - *Explain the environmental relevance of lakes*
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- ***Why physical limnology ?***
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  - *Create interest towards lakes through youngsters*
  - *genius loci*
  - *Scientific Completeness*
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SOME PRELIMINARY CONSIDERATIONS

• ***Why science communication ?***	•*Explain the environmental relevance of lakes* •*Foster citizen science*
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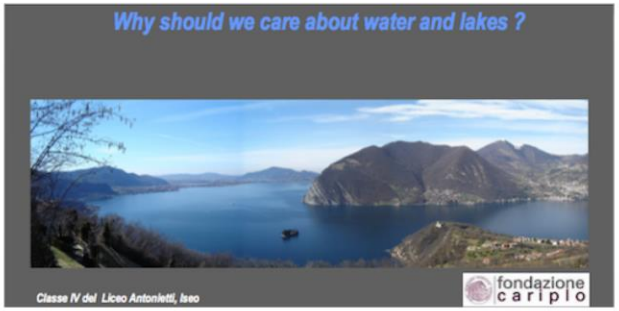
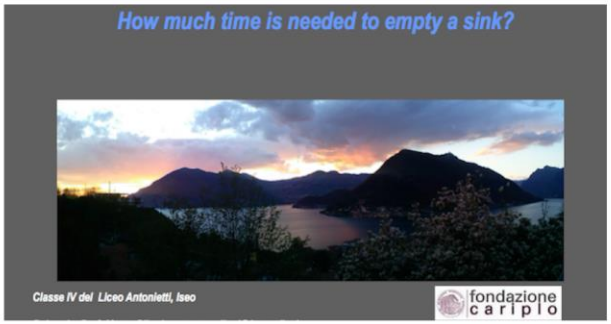
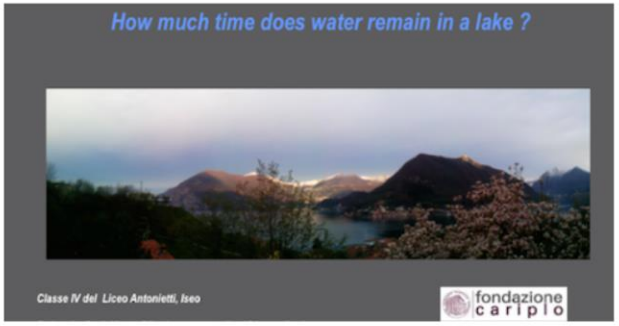
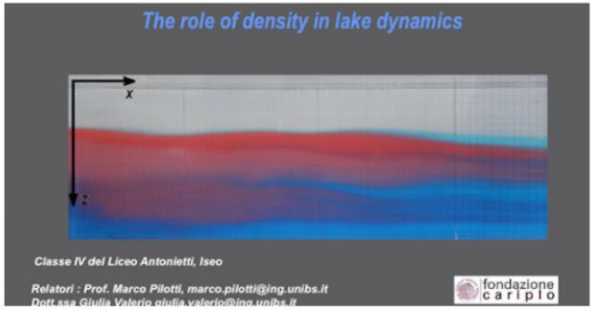
•***Why Secondary Schools ?***	•*Topics fit the Liceo Scientifico curricular program* •*Alternanza Scuola Lavoro*
•***How to communicate***	•*Informal but scientifically sound* •*Original Lectures +, Direct involvment through experiments* •*Data manipulation through Spreadsheets and programming*
•***When and who***	•*Liceo Scientifico Calini, Brescia;* •*Liceo Scientifico Leonardo, Brescia;* •*Liceo Antonietti Iseo*

TOPICS COVERED BY THE 10 SEMINARS

First Slide of the seminar	Leading Idea	Method	Curricular Competence
	Why water is important	• Analysis of Hydrologic Balance • Statistical analysis of the average water consumption of the students in the class	• natural science • statistics
	Physical law have a predictive power	• Experiments of mass conservation with a simple reservoir • Use of a Spreadsheet	• physics • math
	Simple models must be refined to get the right answer...	• Experiments of pollutant dilution with time in a CSTR	• physics • math

TOPICS COVERED BY THE SEMINARS



If thermal stratification is at play, the model must be further refined ...

- **Physical model of a stratified lake, with visualization of overflow, intrusion and plunging flow**
- **Internal waves by artificially generated wind**

- **physics**
- **math**

Sometimes a spreadsheet is not the easiest way to deal with the problem ...

- **Introduction to the implementation of simple algorithm with a free PASCAL compiler**

  roots of a second order equation
  Cramer's rule for a 3x3 system
  recursive equation for mass conservation

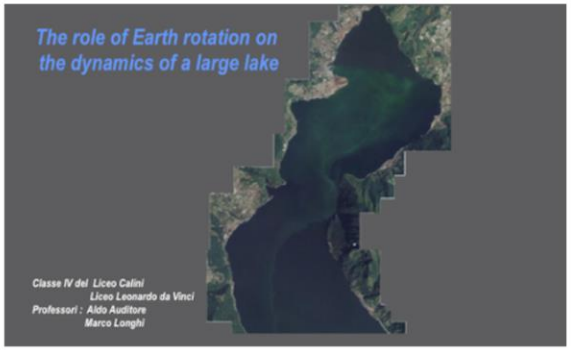
- **algorithmic thinking**
- **math**
- **computer science**

The importance and implication of the energetic balance of a lake

- **hands on working on the data measured by our LDS**
- **Computation of energy balance with a spreadsheet and with a simple code**

- **physics**
- **math**
- **computer science**

TOPICS COVERED BY THE SEMINARS



Earth rotation has a role to play...

- **Visit to the laboratory at the University**
- **Physical experiment exploring the role of Coriolis' force on the lake inflows**
- **Physical experiment on Taylor's columns**

- **A glance on the world of University and Research**

Physics, chemistry and Ecology of a lake are deeply interconnected

- **The chemistry of photosinthesys**
- **The Lotka Volterra Model**
- **A simple code to solve the Lotka Volterra system of equations**

- **chemistry**
- **ecology**
- **math**
- **computer science**

Is it only Theory ?

- **Measurement campaign in lake Iseo**
- **lake trip to the LDS**
  Use of an oceanographic probe
- **Use of a Van Dorn bottle**
- **Use of Secchi disk**
- **Evaluation of P and N content in deep and epilimnic waters**

- **Experimental skills in the field**

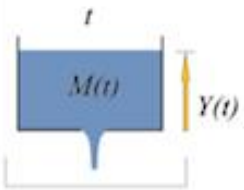
TOPICS COVERED BY THE SEMINARS

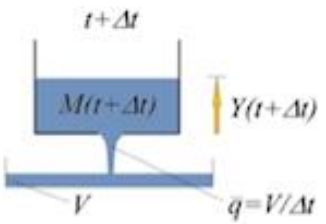
Let us explore the multifaceted reality of the environment where we live

- **Group Assignements on topics selected from a wide list of proposals regarding the lake and the surrounding environment**

- **Group working**
- **All the skills listed above**
- **Set up of a Final Report**
- **Set up of a presentation**

Seminar 2





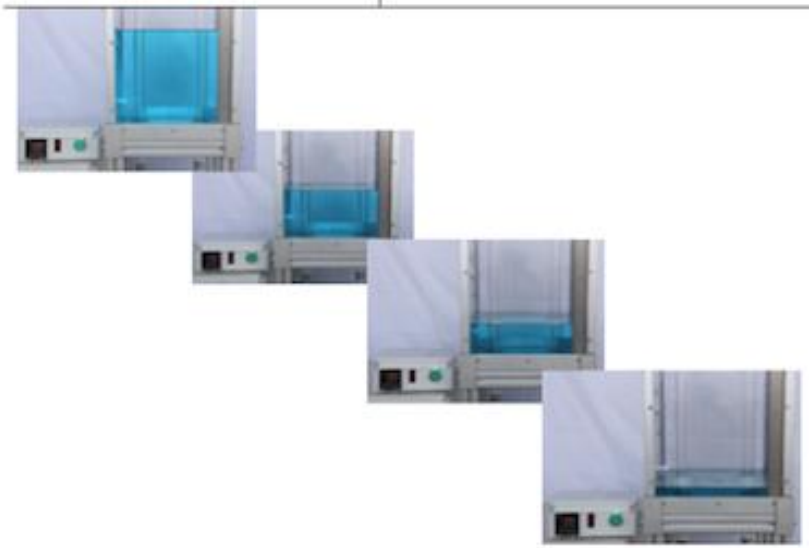
$$M(t) = \rho \cdot A \cdot Y(t)$$

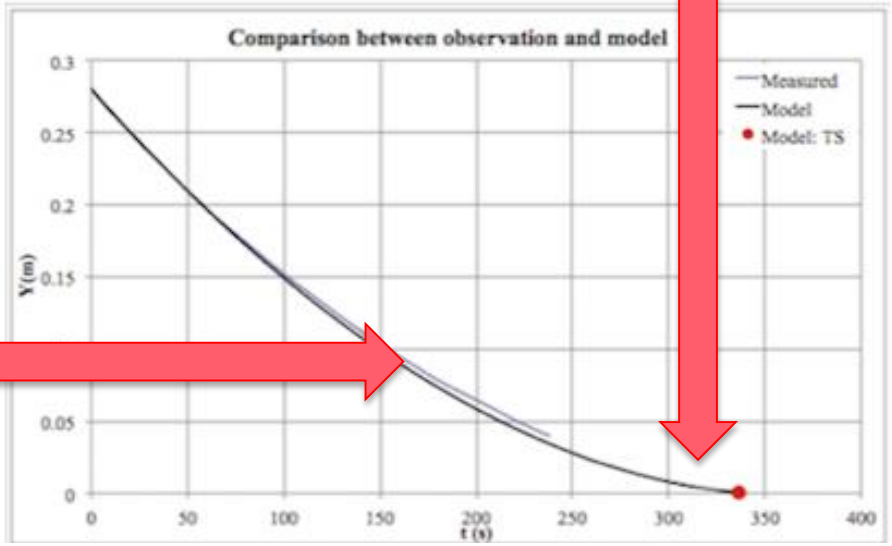
$$M(t) = M(t+\Delta t) + \rho \cdot V$$

$$M(t+\Delta t) = M(t) - \rho \cdot V$$

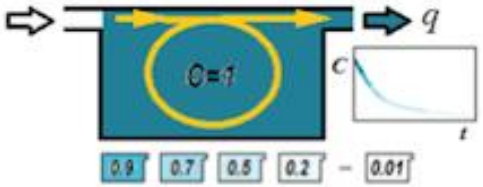
$$Y(t+\Delta t) = Y(t) - \frac{V}{A}$$

$$Y(t+\Delta t) = Y(t) - C\sqrt{Y(t)} \quad C = \frac{a\sqrt{2g}\Delta t}{A}$$





Seminar 3



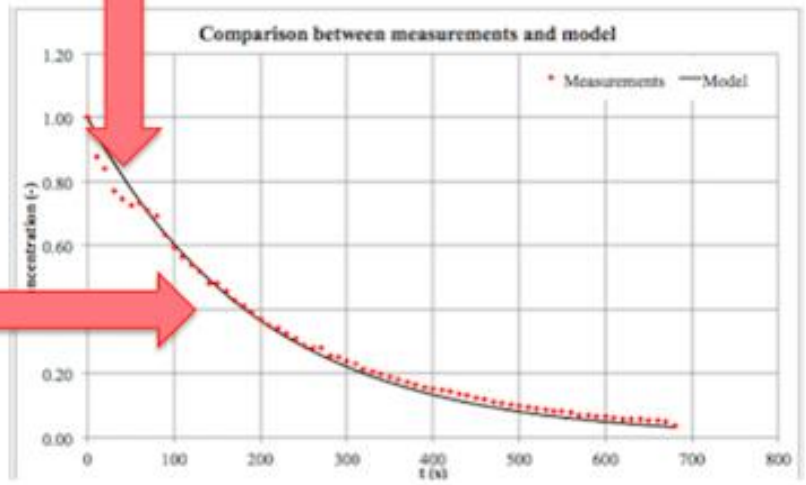
$$C = V/V_L$$

$$V(t+\Delta t) = V(t) - C(t)q\Delta t$$

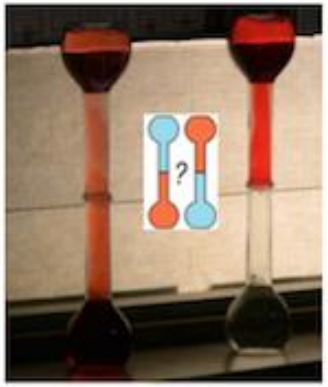
$$\frac{V(t+\Delta t)}{V_L} = \frac{V(t)}{V_L} - \frac{C(t)q\Delta t}{V_L} = \frac{V(t)}{V_L} - \frac{C(t)\Delta t}{T_R}$$

$$T_R = \frac{V_L}{q}$$

$$C(t+\Delta t) = C(t)(1 - \frac{\Delta t}{T_R})$$

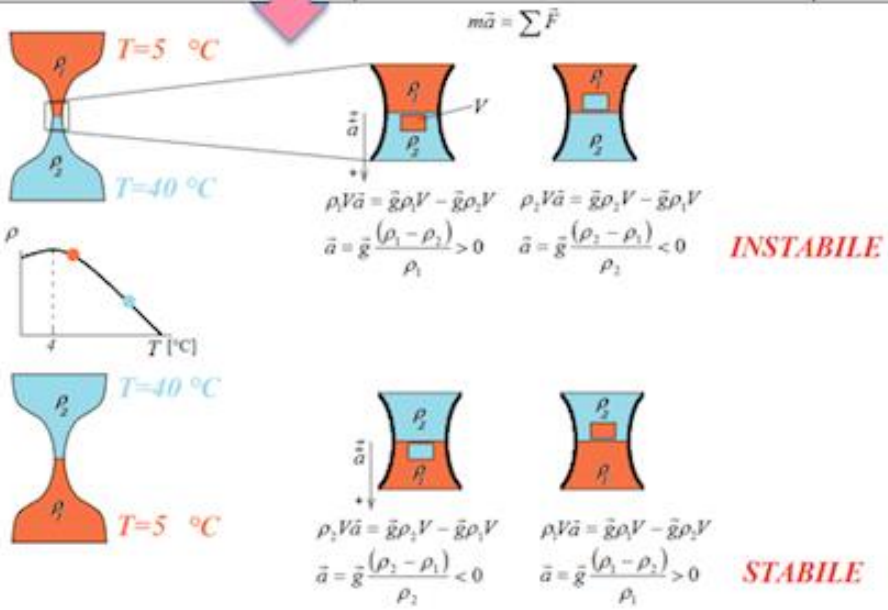


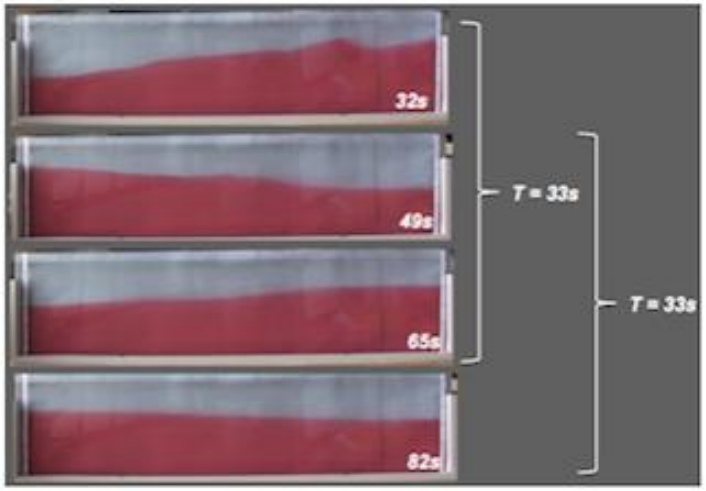
Seminar 4



$$T = \frac{L}{\sqrt{g\,\frac{\rho_2 - \rho_1}{\rho_2}\,\frac{h_2 h_1}{h_2 + h_1}}} = 30s$$

$m\vec{a} = \sum \vec{F}$





Protected: Ciclo seminariale Licei Calini e Leonardo – Brescia

In questa sezione è raccolto il materiale didattico utilizzato nell'ambito del progetto "Il lago, genius loci del territorio bresciano, occasione di introduzione al pensiero scientifico", rivolto agli studenti del liceo Calini e del Liceo Leonardo (anno scolastico 2014-2015) e coordinato assieme ai docenti dei corsi di Fisica e Matematica, Prof. Aldo Auditore e Prof. Marco Pietro Longhi. Questo progetto è cofinanziato dalla Fondazione della Comunità Bresciana Onlus.

- Questionario relativo al consumo_di acqua da completare da parte di ciascun studente
- Seminario_1.pdf
- Presentazione_delle_interviste.pdf
- Intervista a Steven Chapra, Tuft University, Boston
- Intervista a Charlie Hogg, PostDoc, Cambridge University
- Intervista a RobertaFornarelli, Environmental Engineer in Perth, Australia
- Intervista a NinoFrosio, ingegnere, esperto di utilizzo idroelettrico delle risorse idriche
- Seminario_2
- Seminario_3
- Seminario_4
- Seminario_5
- Seminario_6
- Seminario 7 (4/5/2015 con foglio elettronico sottostante)

Materiale di supporto relativo ai diversi seminari

- Elenco delle domande poste durante le interviste e spiegazione di alcuni termini utilizzati
- Mappa delle precipitazioni medie annue in Lombardia
- Report UNESCO sui Flussi virtuali di acqua
- Report USGS sulla misura della conducibilità
- Seminario2_foronomia.xls
- Seminario3_sul tempo di ricambio in un serbatoio.xls
- Seminario 5: fogli elettronici Analisi_dati_temperatura e Bilancio_energetico_giornaliero
- Seminario 6: articolo scientifico sul modello fisico del Lago d'Iseo
- Seminario 7: Foglio di calcolo sulla dinamica delle popolazioni
- Articolo divulgativo sull'eutrofizzazione
- Articolo scientifico sull'eutrofizzazione

Italy	16613 (89 %)
United States	511 (3 %)
Austria	155 (1 %)
United Kingdom	146 (1 %)
Netherlands	82 (0 %)
Germany	82 (0 %)
France	79 (0 %)
Spain	54 (0 %)
China	49 (0 %)

Total Visits: 18393

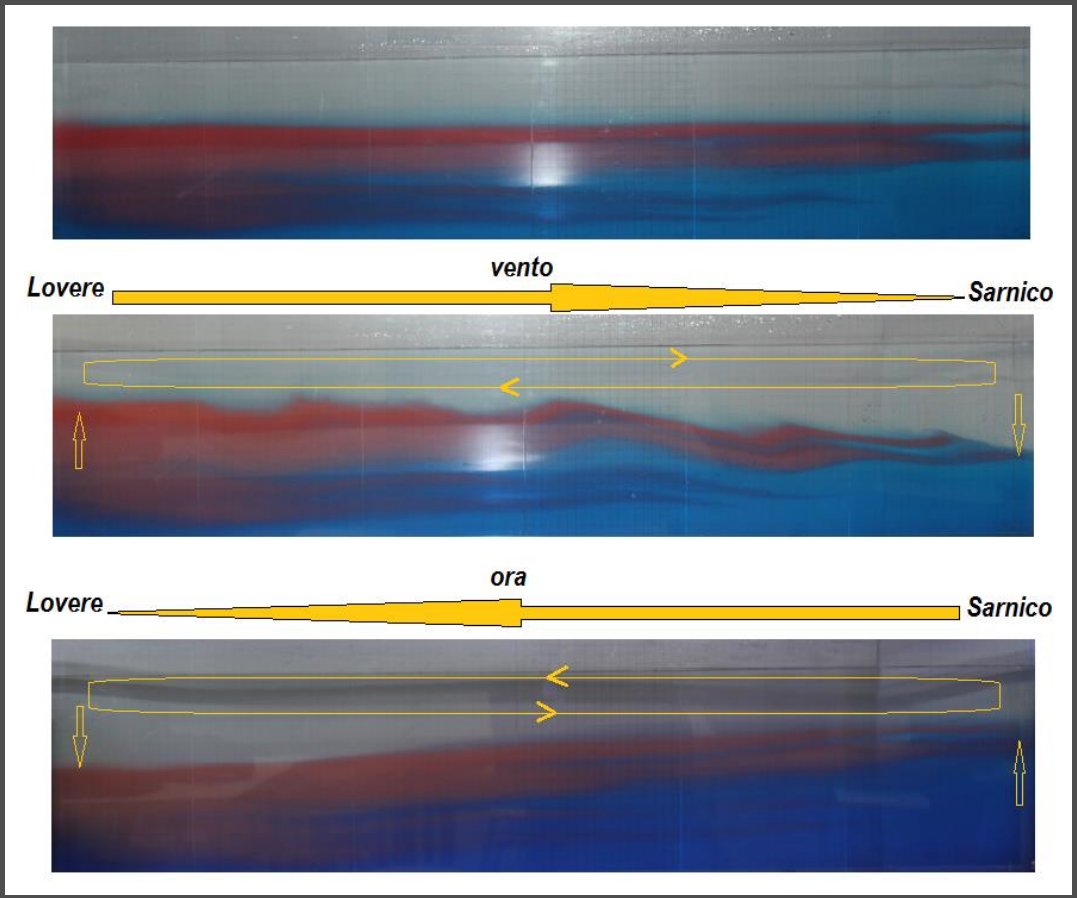
ACKNOWLEDGEMENTS

The activities partly presented in this presentation have been made possible also thanks to a grant by Fondazione della Comunità Bresciana, that, in 2014-2015 funded our project

"Il lago, genius loci del territorio bresciano e occasione di introduzione al pensiero scientifico"

and by fondazione CARIPLO, through the dissemination part of the ISEO project.
Their help is kindly acknowledged

THANK YOU FOR YOUR ATTENTION



Is somebody interested in exploring a H2020 proposal on citizen science ?