

Popular science & education

A mathematician's point of view

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POPULAR SCIENCE

- A social role :
 - Recognizing everybody's relevancy with respect to questions of science (mathematics being a part of it).
 - Avoiding restriction to a top-down approach.
 - A ~~citizen~~ humanist attitude ?
- For researchers : meeting parents and general public, learning how to interact with them, and learn in return ...
- Experiencing research.

EDUCATION : STAKES FOR KIDS

- Social.
- Change of viewpoint : on a given topic, on mathematics on a whole, transversally, with an emphasis on stageing.
- Curriculum discussions.
- Cultural dimension : what are the rules, goals and stakes of mathematics ?
- Research situations : towards a model/counter-model approach.

STAKES FOR TEACHERS

- Social role, for math teachers, but not only (mostly not ?) :
 - IREM (Research institute on math teaching)
 - APMEP (math teachers association)
 - academic referents.
- Resources (specially for primary school teachers), interactions and networking.
- Academic training.

USUAL WAYS

- The easiest way of designing things is to avoid interactions ! But if researchers come in contact with kids, they should not fear to actually get involved in a more open way ...
 - Movie show
 - Stand-alone posters or exposition
 - Conferences (BNF, Animath)
 - Static web sites

INTERACTIVE WAYS

- Workshops in situ (Fondation 93, IREM, Science festival/*Fête de la science*) : mostly in secondary schools, but sometimes in primary schools.
- Workshops extra-muros (Salon du jeu et de la culture mathématique, *Fête de la science*, rallye) : any public
- Work experience for students between 14 and 18 years old.
- Movie followed by a debate (11 years old and up).

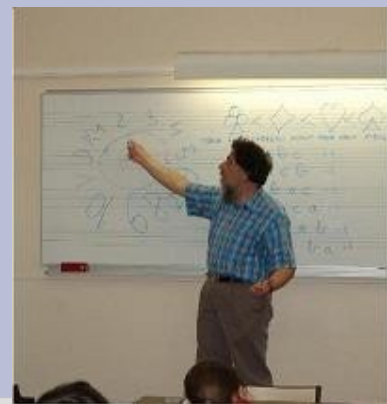


EXPERIENCING RESEARCH

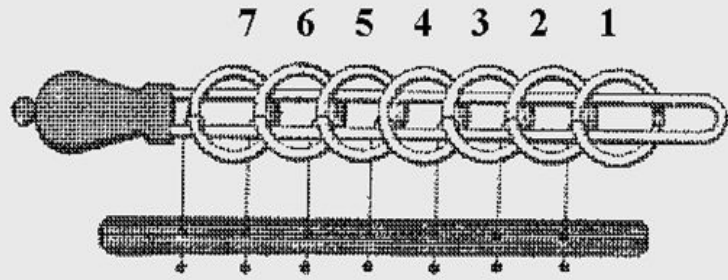
- Open problems given to the whole classroom
 - Without any researcher during research : rallye
 - With a researcher (specially with a didactic study in mind) : research narration, SiRC (Research situation in the classroom - Grenoble)
- For small groups within a given classroom : hippocampe (Marseille).
- For small group on a voluntary basis : Math.en.Jeans, math clubs (Animath).



OPERATING MODES



- Stageing or finding links with pertinent themes in society (and with some mathematical or pedagogical contents in mind).
- Construction of meaning by getting friendly with mathematical words.
- Stageing individual questions & collaborative ones.
- Towards abstraction & polysemy via model building.
- Concept drift : fuzzy bridges, metaphors, analogies.



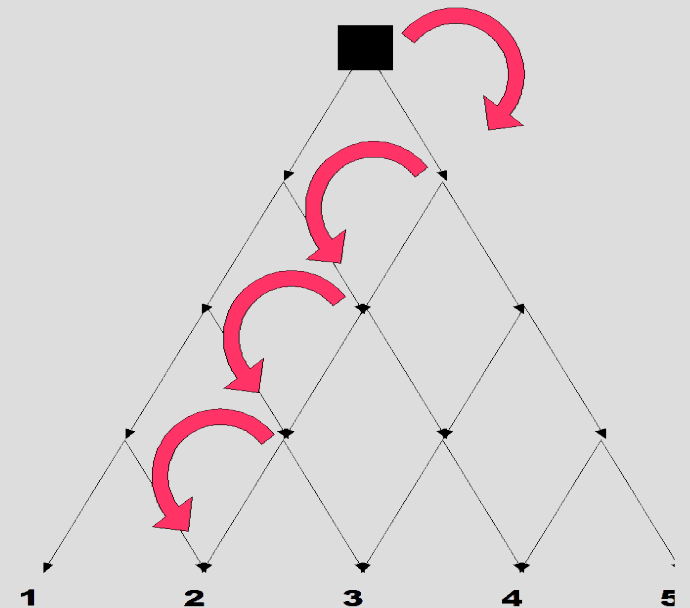
EXAMPLES



- Open a free newspaper and take an(y?) article : make mathematical remarks.
- Stageing by appealing to games or magic (automatic tricks).
- Drift from chinese ring puzzle (baguennodier) to hard drive slicing using puzzles & Zome-tools :
 - Geometric interpretation via binary encoding
 - Cubes & hypercubes, a glimpse into space-time
 - Hamilton path on a cube

JUSTICE & CHANCE BRINGING DEBATE IN PRIMARY SCHOOLS

- Sharing a gain or a loss in a « wedding contract » : mathematical debate in a classroom on a playground issue.
- The point is that there is no unique answer and each people point of view does evolve during his/hers lifetime.
- Probabilistic point of view :
 - Third party comes in.
 - Gambler's ruin.
- Sharing resources : a « gaussian » hopscotch.



BRINGING CHALLENGES IN THE CLASSROOM

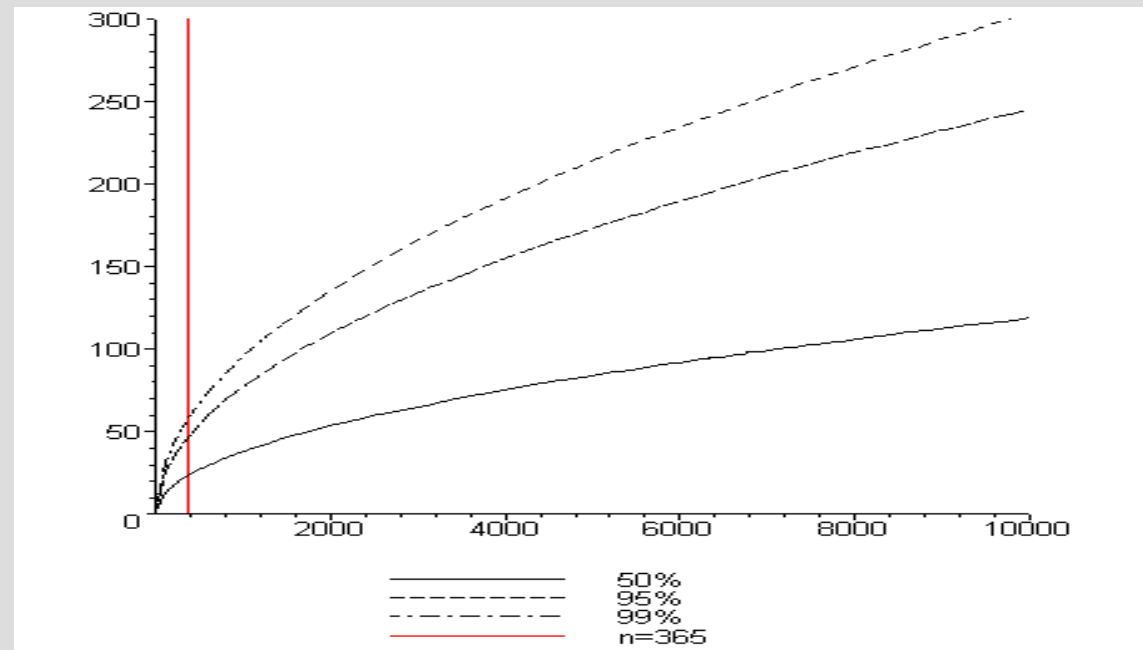
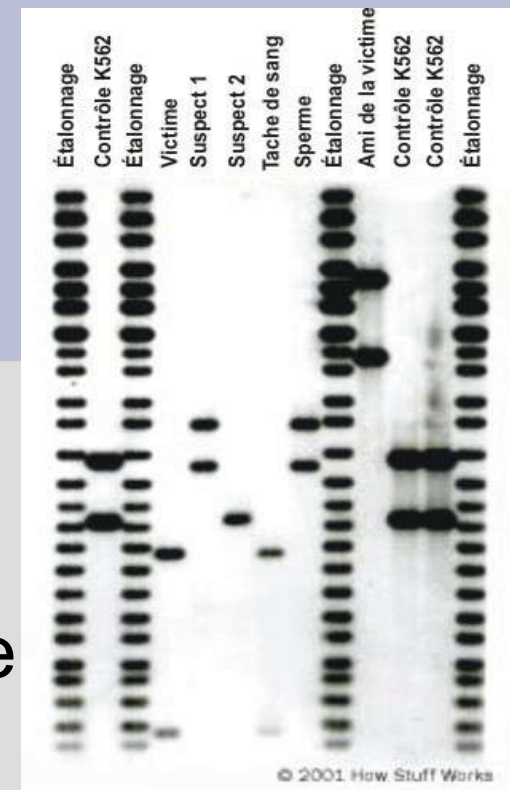
- Phil Defer, the thinnest mathematician in the world : he can pass through a sheet of A5 paper !
- How about you ?
- Like Houdini, I can wrap myself with a rope and get free !
- I actually wrap my fingers and get free while you hold all my fingertips but one.
- Can you do that ?



NB. Phil Defer is a play on words « fil de fer » means « wire » in french

DNA EVIDENCE ANOTHER LOOK

- Questions about DNA evidence :
 - Chance and risk in society, in biology.
 - Success means uncertainty while failure means certainty ...
 - Noncoding (junk) DNA vs. coding DNA.
- Links to probability tests, birthday problem (or birthday paradox).



INFORMATION THEORY

- Mathematical structuring
- Model building
- Even if the information can be summed up as numbers, there is a profound need to show non numerical situations : mathematics cannot be restricted to be the science of numbers !

PRE-READING SITUATIONS

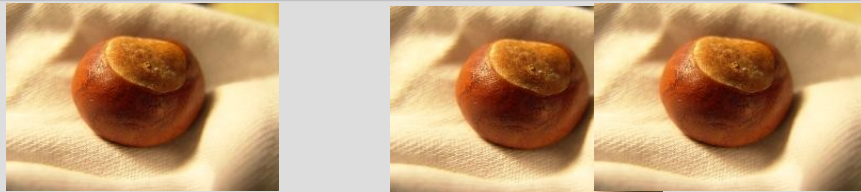


- Put some chestnuts & two fruits on a table and make two groups of people.
- Each group first gets some chestnuts and then takes a fruit.
- Depending on the fruit, each group can take more chestnuts.



Viewing the number of chestnuts left, decide which group took which fruit.

STAGEING



$$9 - (1 + 2) - (2 \times 2 + 1 \times 1) = 1$$

Group 1 took fruit 1



$$9 - (1 + 2) - (2 \times 1 + 1 \times 2) = 2$$

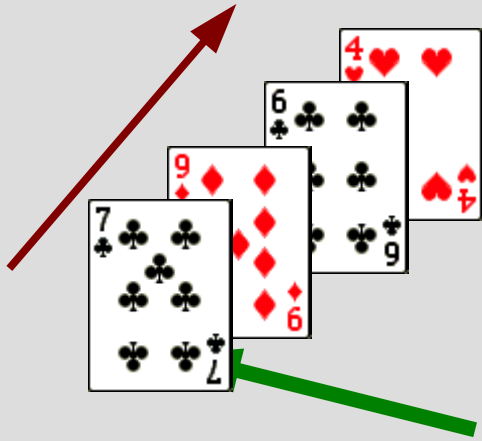
Group 2 took fruit 1

EXTENSION

- 3 groups, 3 fruits, 24 chestnuts.
- 1, 2 or 3 chestnuts at start.
- Once, twice or 4 times the initial number of chestnuts.
- 1, 2, 3, 5, 6 or 7 left.
- One-to-one functions
- Numeration : $\sum n_i 2^i$?
- Approximate or memorize ?



REDUNDANCY ERROR CORRECTING



- People in a row, each sees card of people in front of him but not his/hers nor those of people behind.
- Each has to guess one's card, starting by the last in the row and forward ...
- Guess only red/black or suit. Restrict to numbers.
- Individual strategy vs. collaborative strategy.
- Probabilistic analysis vs. probabilistic strategy.
- In a probabilistic strategy, mean expectation is relevant, but standard deviation too !