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## Popularizing nuclear science and technology to students of some Brazilian high schools

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Brazilian Ministry of Science and Technology (MCT)



Ministério da  
Ciência e Tecnologia



# Overall view of the nuclear area in Brazil



Federal Government

Ministry of Science and Technology

Ministry of Mining and Energy

Brazilian Nuclear Regulatory Commission (CNEN)

INB

ELETRONUCLEAR  
Thermo-nuclear Company

*Rio de Janeiro*

*Mining and nuclear fuel production*

*Angra dos Reis -Rio*

Research and Development  
Directory

Radioprotection and  
Nuclear Safety Directory

Nuclear Power Plants  
Angra I and II

CRCN

*Recife*

IEN

*Rio*

IPEN

*São Paulo*

CDTN

*Belo Horizonte*

*Rio*

IRD

*Nuclear R&D Institutes*



# CDTN location in Brazil



*Minas Gerais State*

*Belo Horizonte City*



Total area : 240,000 m<sup>2</sup>  
 Constructed area: 30,000 m<sup>2</sup>  
 Perimeter: 2.36 Km

## 1 Introduction

*Nuclear technology: public acceptance*

*Nuclear technology X Public high school education*

## 2 Project methodology

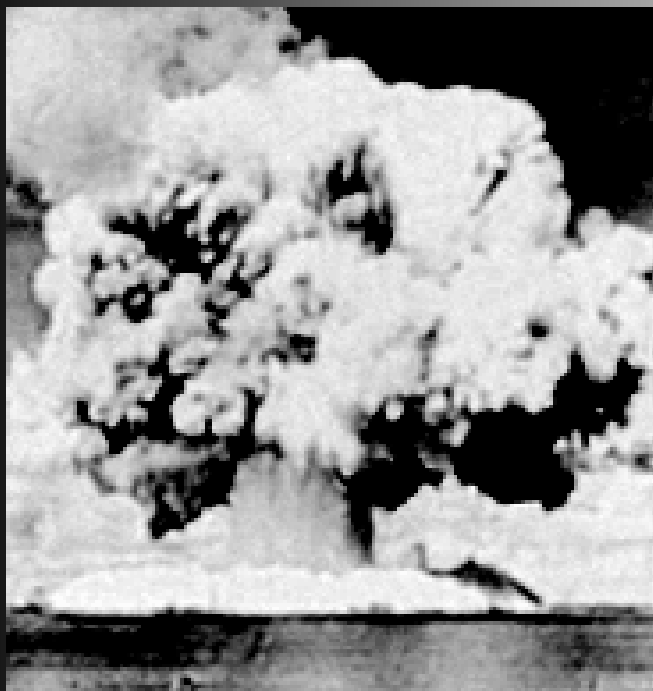
- *Target public survey*
- *Team training*
- *Project execution*
- *Project evaluation*
- *Project dissemination*

## 3 Results

## 4 Conclusions

Nuclear technology brazilian scenary: public acceptance

Atomic weapons

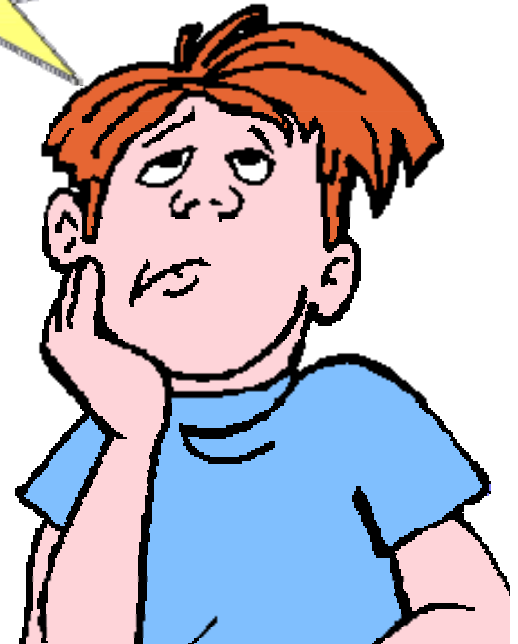
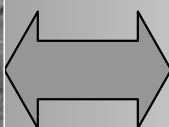


What to do in order to change this first image?



Nuclear technology?

Chernobyl accident



***The answer would be:***

*Show peaceful and social applications of the nuclear technology!*

***What would be the target public of such actions?***

*In our Centre (CDTN) the strategy is to give focus mainly on high schools and college students.*

***Since then are these actions been done?***

*For about 20 years students are being received at CDTN with talks and visits to some installations or receiving talks at the schools.*

*Other more recent actions are CDTN Open Doors and participation in the Brazilian National Week on Science and Technology.*

***What is the results of such actions in terms of target public reached?***

*More private schools reached then public schools!*

History

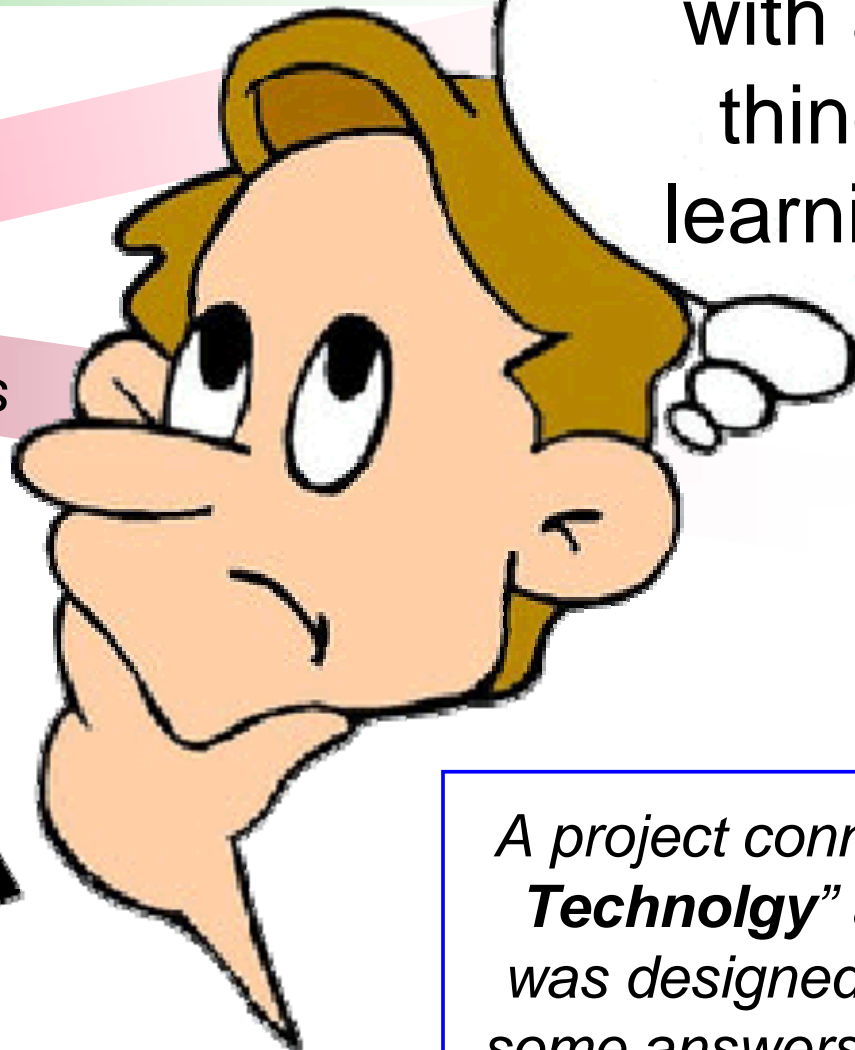
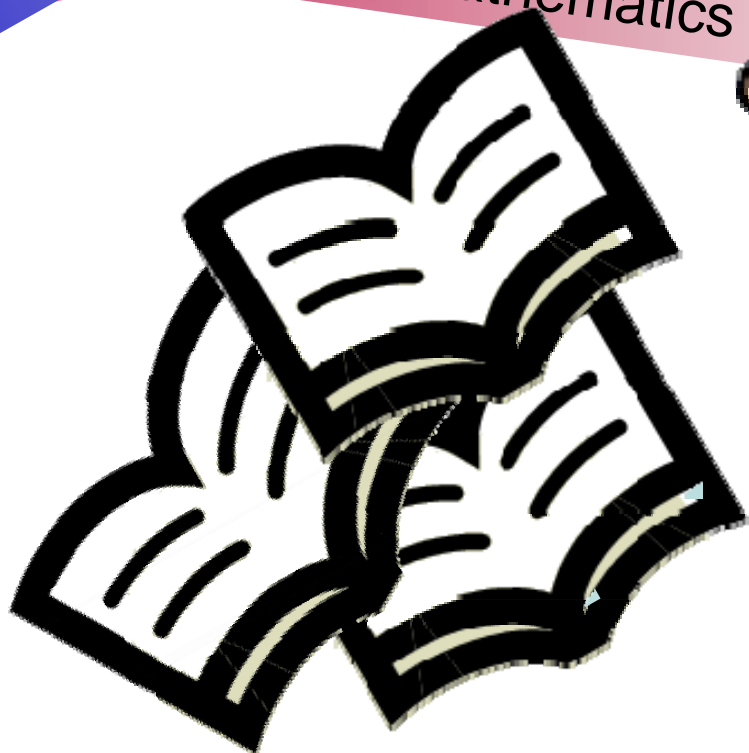
Geography

Physics

Biology

Chemistry

Mathematics



What will I do  
with all these  
things I am  
learning now?

*A project connecting “**Nuclear Technology**” and **Education** was designed in order to give some answers to this question!*

## **Target public:**

*Mainly high public schools students from the metropolitan region of Belo Horizonte – Minas Gerais state – Brazil.*

## **Main objectives:**

*Stimulating the students for subjects, like physics, chemistry, biology, mathematics, history, etc;*

*Awakening vocations to science and technology;*

*Contributing for having citizens able to question the uses of science and technology.*



## In what consisted this project?

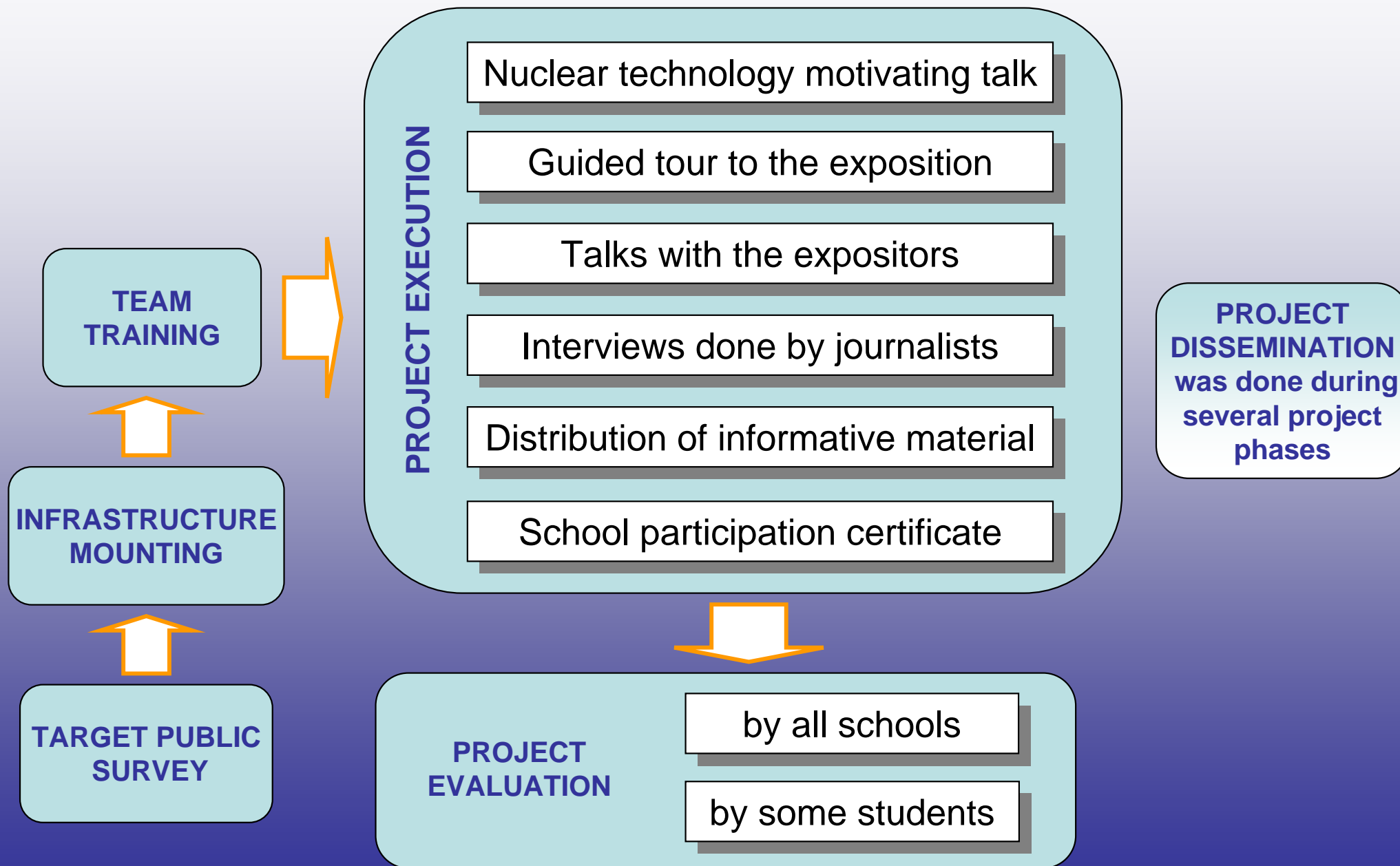
*It consisted basically of an **introductory talk** on fundamentals and applications of the nuclear energy and ionizing radiation followed by a visit to a **nuclear stand exposition**.*

*The talk had as goal to **motivate** the audience to the nuclear theme and at the same time associating it to subjects taught at schools.*

## What was the duration of the project? (2005-2006)

*The visit to each school was done in **one or two days** depending on the number of students. In general only in one morning period.*

# General view of the whole project



Small scale of a nuclear power plant (type Angra II)



Small scale of a nuclear research reactor core (TRIGA)



Exposition stand

Food irradiation exposition



Small scale of a Gamma Irradiation Laboratory



Talk in a open sport place



Samples of multimedia materials  
used in the talks

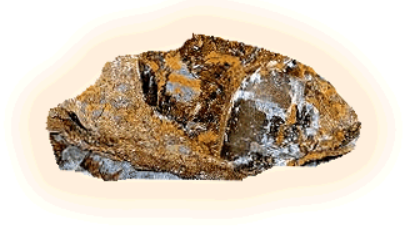
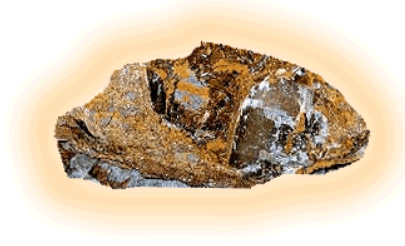
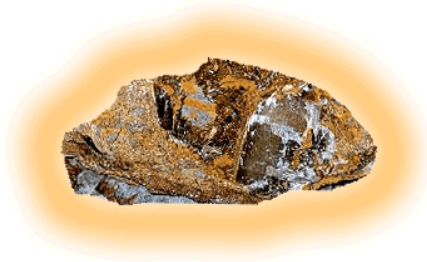
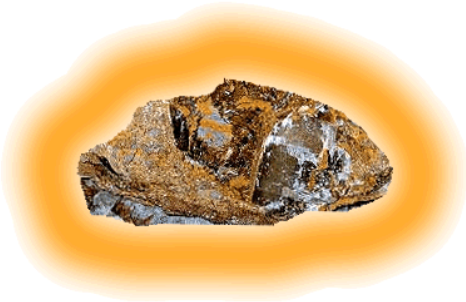
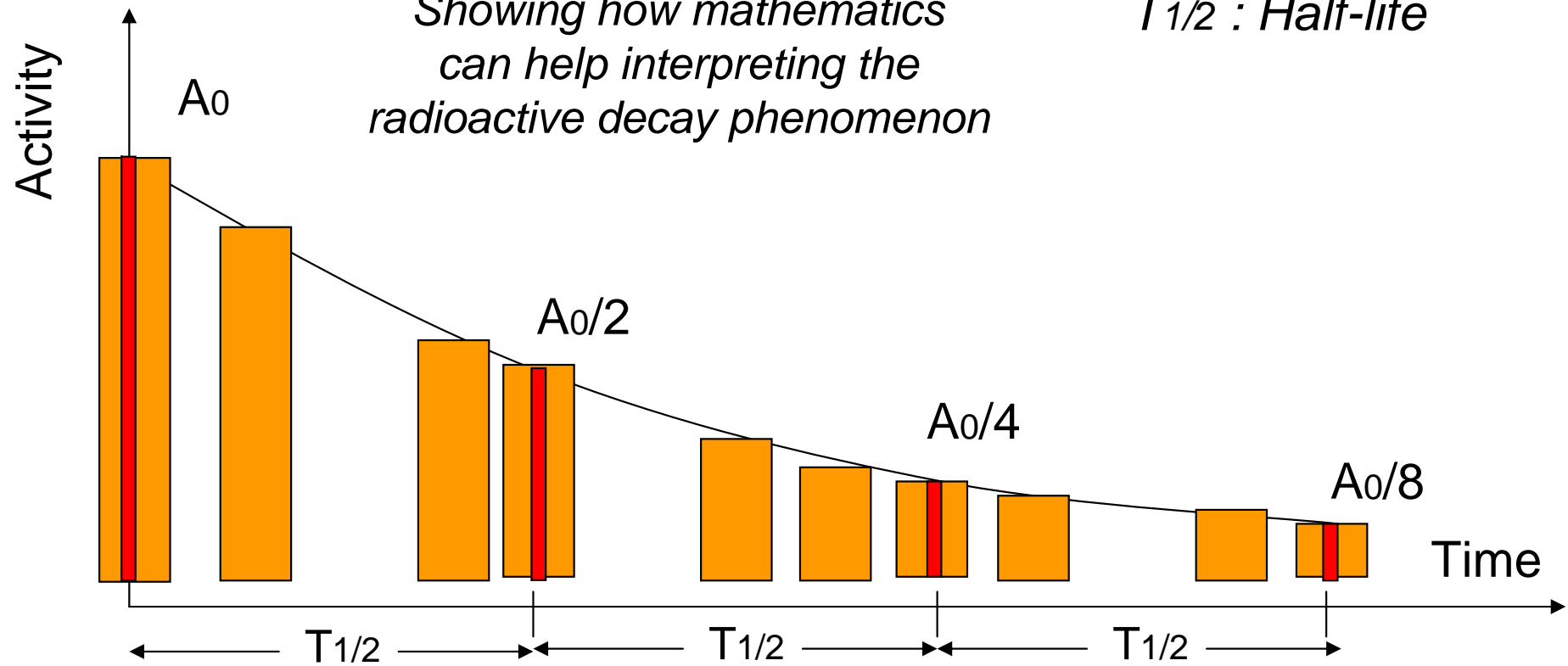


# Half-life of a radioactive material

MATHEMATICS

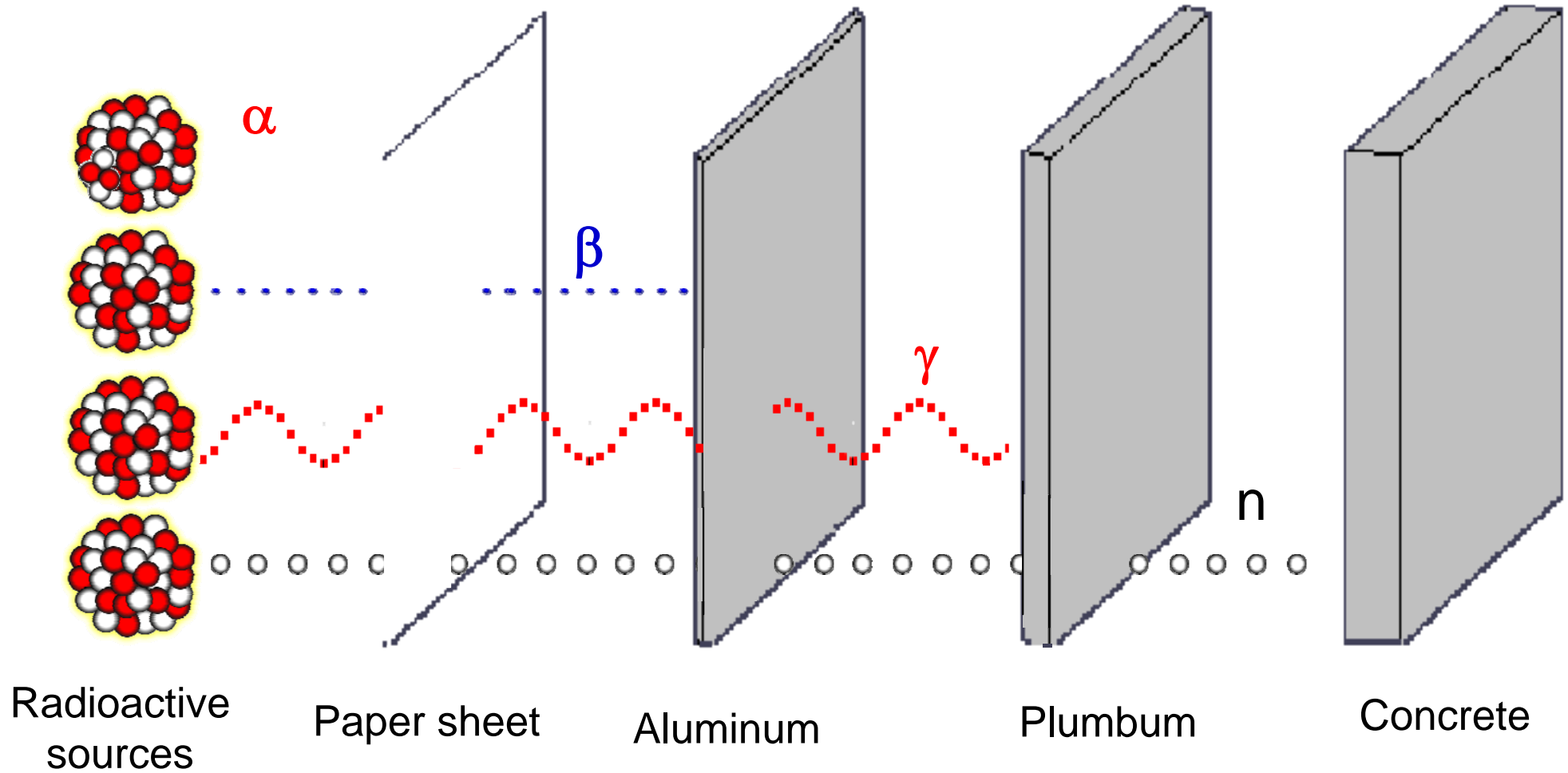
*Showing how mathematics can help interpreting the radioactive decay phenomenon*

$T_{1/2}$  : Half-life



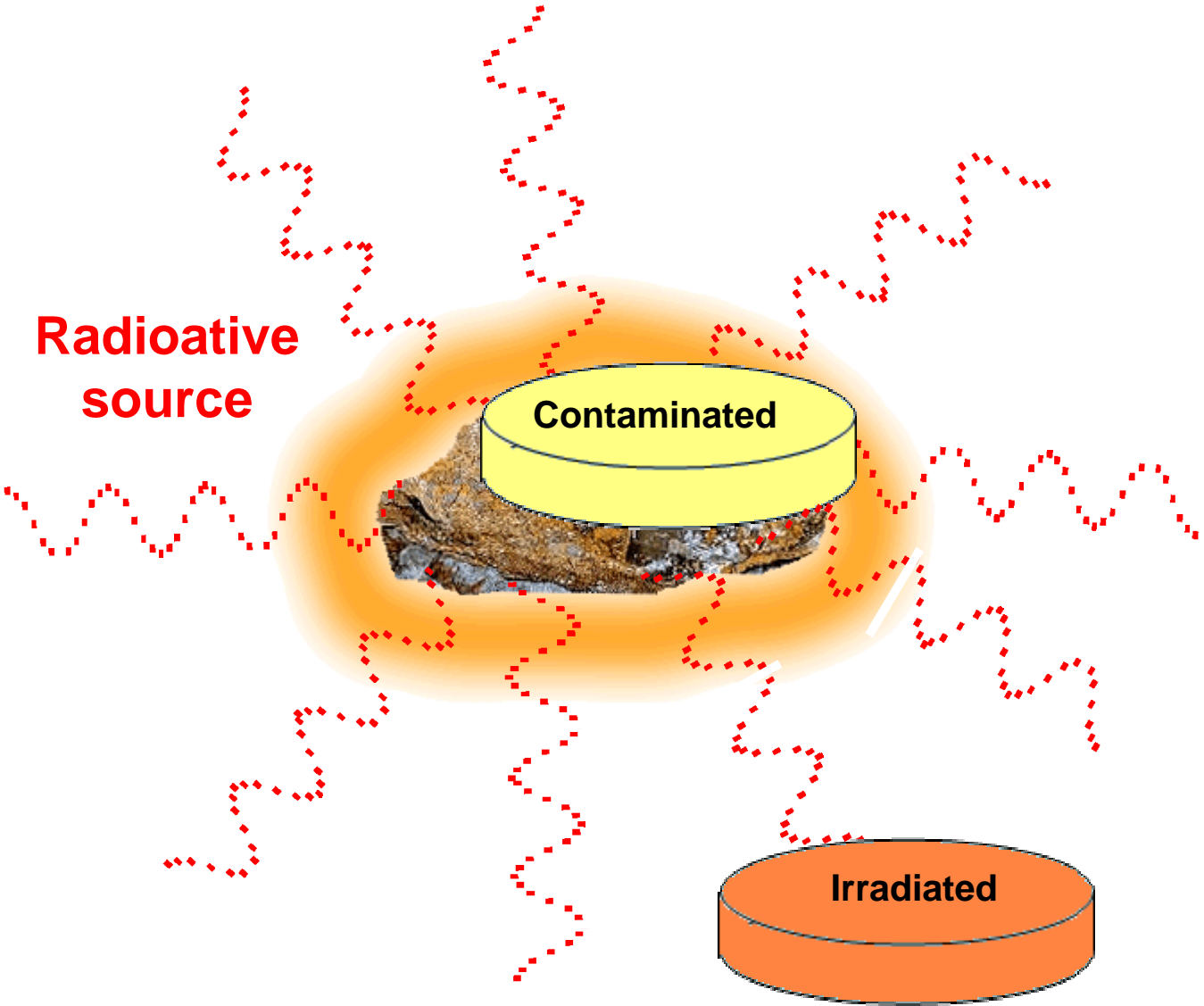
# Radiation barrier

PHYSICS



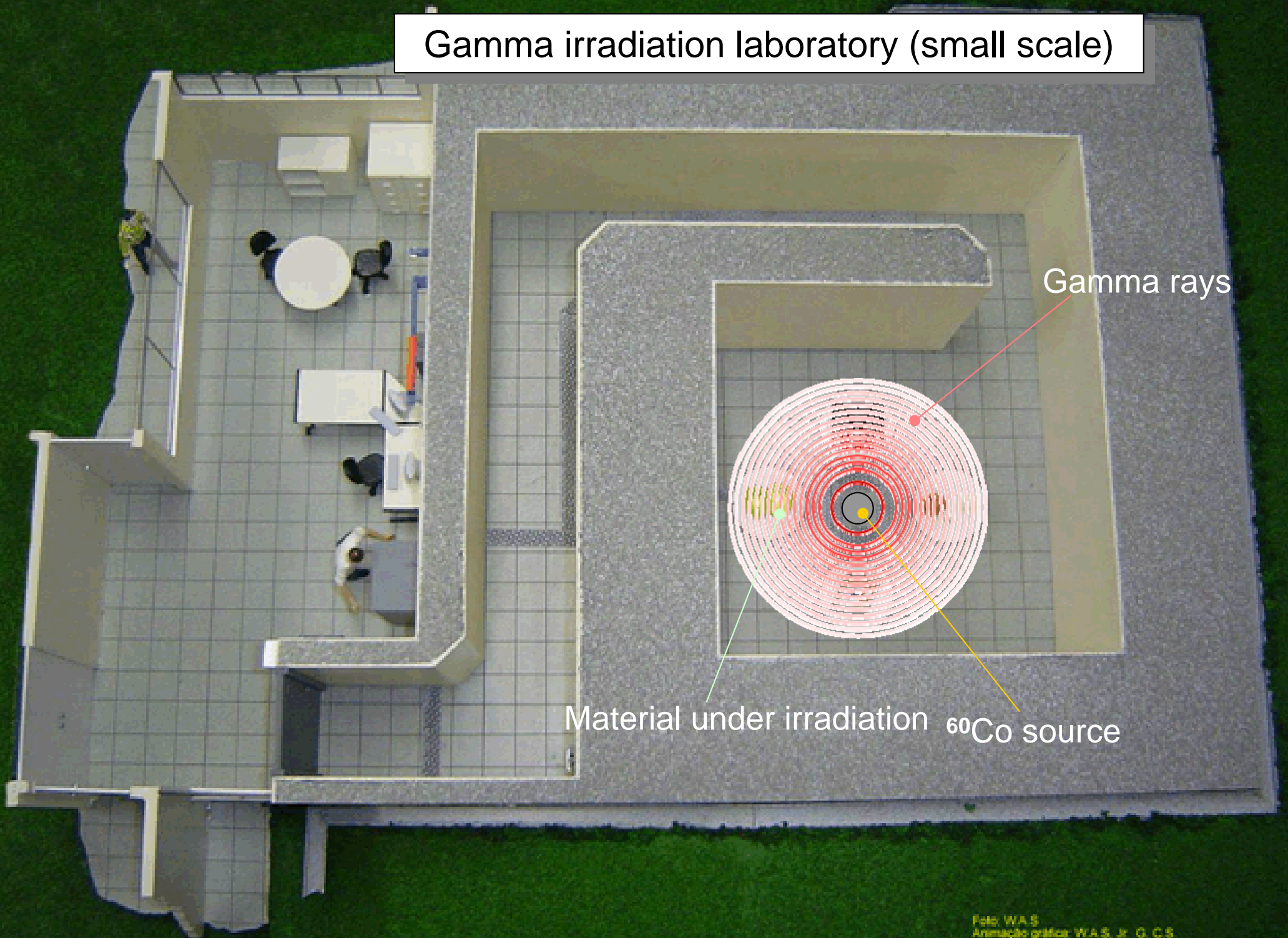
*Showing that engineering barriers can be used in order to protect people when using radiation.*

# Contamination Versus Irradiation



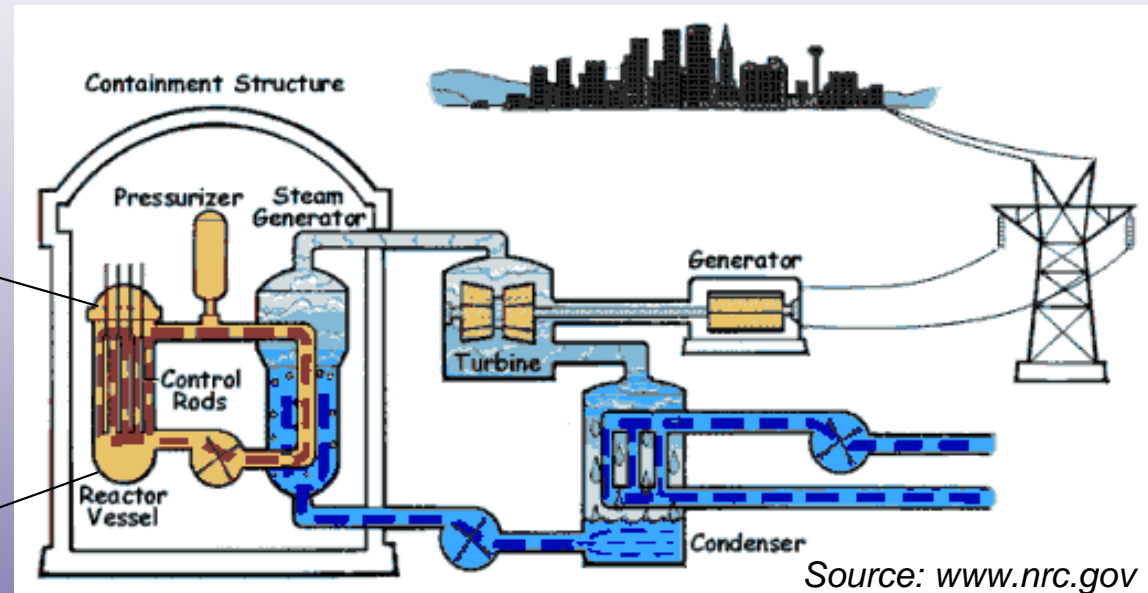
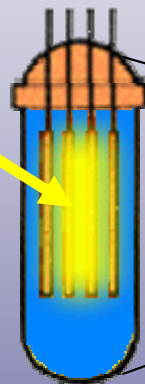
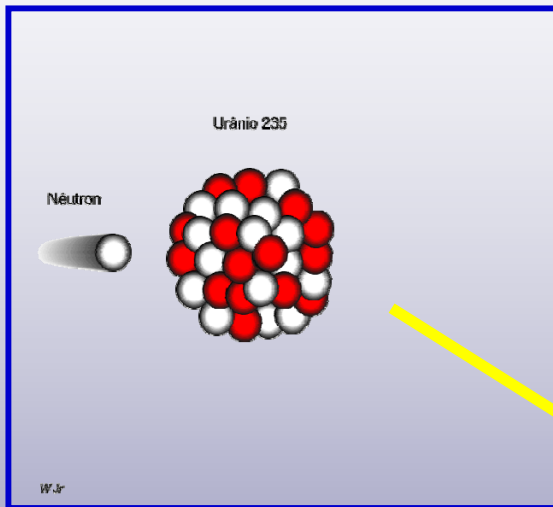


# Gamma irradiation laboratory (small scale)



Showing how a PWR works in order to generate electricity.

$^{235}\text{U}$  fission



Students were called attention that the theory learned at high school are basic knowledge used in the design of important technologies like the nuclear one.

A phenomenon that can be observed in the kitchen

# Results

Results

# *Moments of the project.*



*Talking in a large auditorium*





*Talking at class room.*



*Journalist interviewing a student.*



*Talking about gamma irradiation lab.*



*Colored gems by irradiation.*



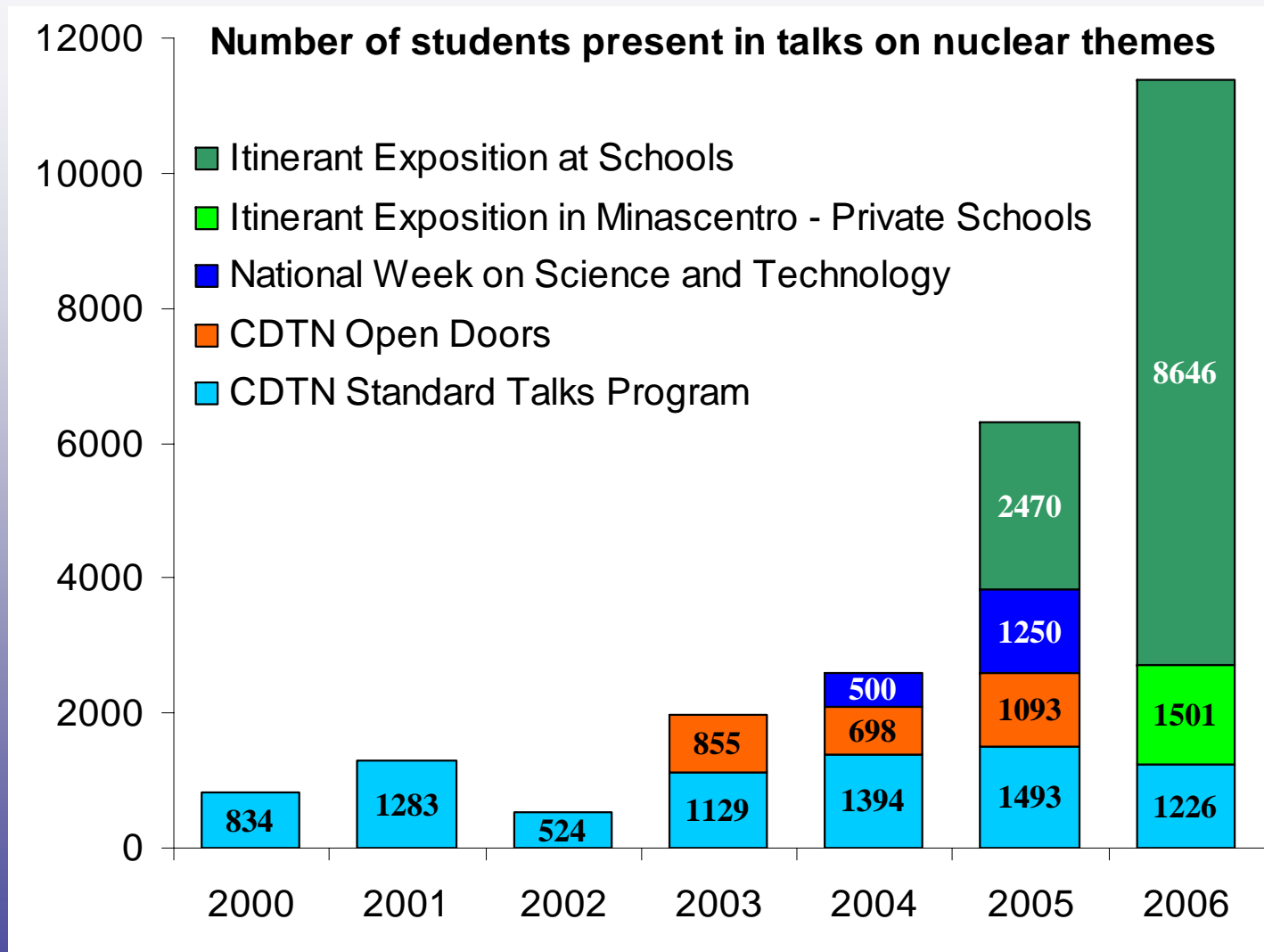
*Talking about food irradiation.*



*Talking about a nuclear power plant*

# Results

*Impact of the project on other science and technology popularization actions done by CDTN.*



2000-2006 Number of students related to the Itinerant project = 12,617 (two years)  
Number of students related to other actions = 12,279 (seven years)

*Project monitoring results*

Indicator name	Results
Number of people involved in the project execution	39
Number of different public schools that took part in the project	30
Number of visits of the project to public schools	36
Number of public school classes reached by the project	294
Total number of students from public schools that took part in the project	11,116
Number of talks presented	64
Number of hour of talks presented	48
Number of students and teachers interviewed by journalists	31
Number of news disseminated internally in the mural newspaper	8
Percentage of the Very Good grade in global evaluation	84.8

*Where the students stimulated to study more?*

*Evaluation of the project based on a sample of 162 students from six public schools three month after the event shows that:*

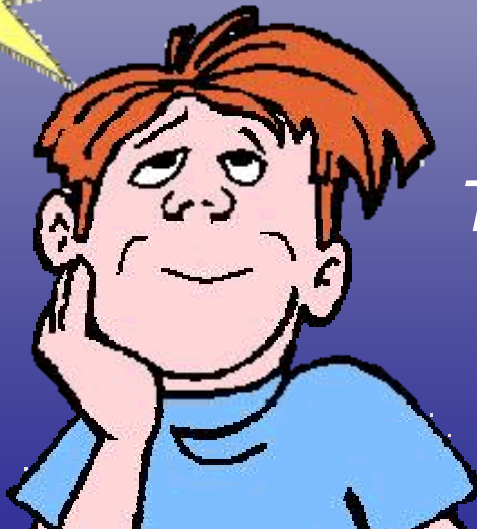
- **55%** of these students affirm that they were stimulated to study more the subjects presented by the expositors;*
- **93.6%** consider important the presented talk and the exposition.*

## Results

*Answers from 164 students of six high schools.*

Associated image	Answers (%)
Utility and applications that the nuclear area can have	42.6
Atomic weapons and nuclear wars	19.8
Danger to people due to the radiations use	17.9
Danger to the environment with the use of radiations	8
Science and technology that the students do not yet know	6.2
Not answered	4.9
None of the other options	0.6

Nuclear  
technology?



*Three months after the Itinerant project!*



# Project awarded by the Minas Gerais state government



*Project coordinator receiving medal given by the daughter of the scientist that gives name to the Premium.*



# Challenges and Conclusions

## Challenges

*Wake up early in the morning to be at schools before class starting;*

*Lack of adequate infrastructure for giving talks and for locating the exposition stand;*

*Repetition of the same talk many times in schools without auditorium or sport places;*

*Teachers in general did not prepare the students to take advantage of the project, as example making the participation as part of a school homework.*



## Conclusions

*The foreseen goal to be at 30 public schools was reached as well as to carry out it in place of great circulation of people.*

*The project contributed in order that CDTN could fulfil its strategic goal to increase the number of public schools reached by the science and technology popularization actions in relation to the number of private schools.*

Before the project

Private: 78%

Public: 22%

After the project

Private: 34%

Public: 66%

*The project was a very good opportunity for the CDTN researchers and technician learning more how to interact directly with society, speaking about the nuclear science and technology with a very questioning public as young students.*

## Conclusions

*The multimedia material developed and the provided infrastructure created propitious conditions in order the students could clarify its doubts with the expositors.*

*The project evaluation results indicate that it contributed to awake the interest of the students for school subjects and also to change the image they have about nuclear energy.*

*Designed initially only to high school students the target public was enlarged, encompassing now high school teachers, pointing out the importance of the project.*



*Talking to high school teachers.*

*Special thanks to:*

*Minas Gerais government Agency for Support of Research (Fapemig) that sponsored the “Nuclear Energy: Itinerant Expositions” project and that make possible this presentation.*

*Minas Commerce Association (ACMinas) a very important partner in the project.*

*Thank you very much!*

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