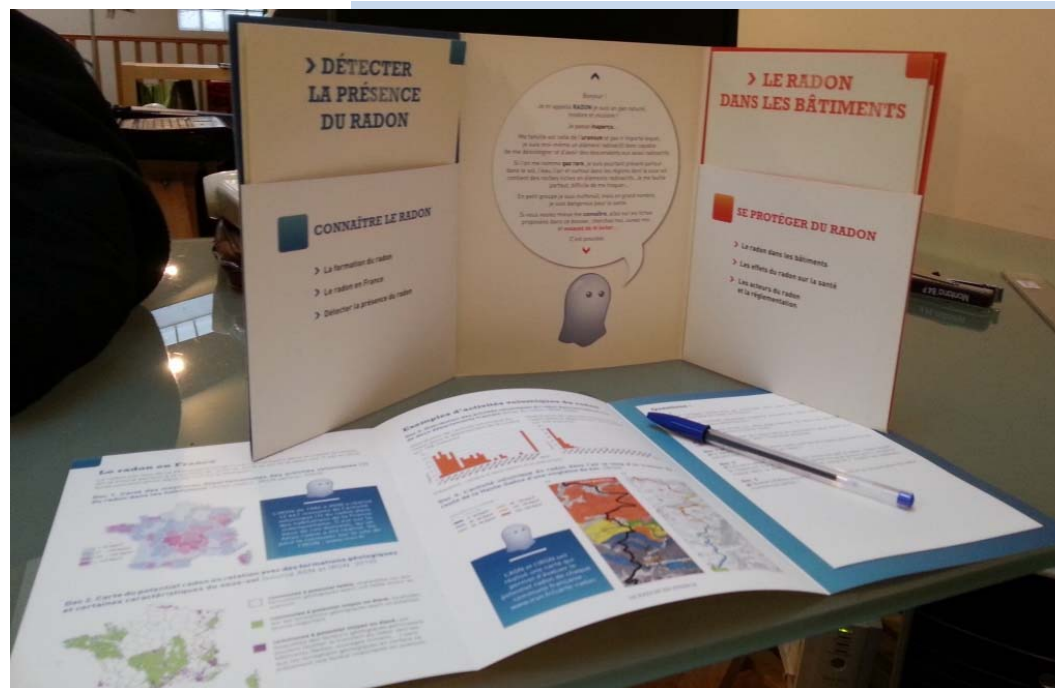


Educational Experiment with active participation of Teachers and Students in the field of Radioactivity and Radon Exposure

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Introduction

- Since 2010 IRSN has an Education and Information Strategy for french citizens to enhance their radiation protection and nuclear safety culture
- One way is to start with the young generation like primary school, high school and university students.
- To obtain a basic knowledge when they become adults

Objectives of the Education Strategy

- a better understanding of what is at stake, enlight their choice as citizens
- Once Adults, they keep a basic knowledge to understand the situation in case of an incident or accident in France. For example as consumers or tourists, their choice depends on their knowledge and consequently their risk perception. This will influence in a positive or negative way the cost of such an event. Their attitude towards the accidental situation will influence the Image of France abroad.
- For long term sustainable development it will hopefully inspire vocations because nuclear activities need scientists to manage safety and radiation protection for a long period of time (for the safe functioning of existing nuclear plants, for dismantling and for existing waste management).

Programs at Schools

Radioactivity and Nuclear aspects are not topics on any school program.

The Education Program IRSN developed on Radioactivity can be easily linked to the few elements, which are given today in French High schools Programs :

- The electrons and nucleus of atoms in physics (but not the disintegration of some of them only in scientific options)
- Environmental risks in geography
- Chernobyl story in history
- DNA and Geology in Natural Science Disciplines

The current situation of French School Programs

Children know little about Ionizing radiation education
About atoms, they know electrons and nucleus (13/14 years old)

The Educative Programs of physics covering radioactivity and nuclear fission are more detailed as a scientific option, which begins at the age of 16 but they are reduced more and more in each new School Program.

Ionizing Radiation is no longer a topic of interest for Physics Teachers :
Today they highlight the physics necessary to understand Climate Change and New Energy Production Systems.

Nuclear Energy seems to be an old fashioned topic for young people.

Interdisciplinary Approach is necessary

- The development of the IRSN Education Exhibition on radioactivity proved that an interdisciplinary approach in schools was necessary
- Radioactivity, its measurements, and the associated challenge cannot be learnt easily in a single discipline.
- It is easier to do this in a multidisciplinary project, but for teachers, it needs coordination and time and the willingness to do that.

Range of Available Tools

- Specific Educations Tools were developed by IRSN in close collaboration with an association involved in Risk Education at schools (IFFO RME) and with the French Nuclear Safety Authority (ASN).
- Primary school and first till third grade Highschool students need different tools than fourth till sixth grade students
- WACH O RISK (GAFFORISK in French) is developed for the 11/14 years old students
- Radon guide for the 14/15 years old students
- Exhibition on Radioactivity for the last grades are the same as for adults
- Movies, small interactive experiments, role plays

6 Education Guides for Radon

LES FICHES

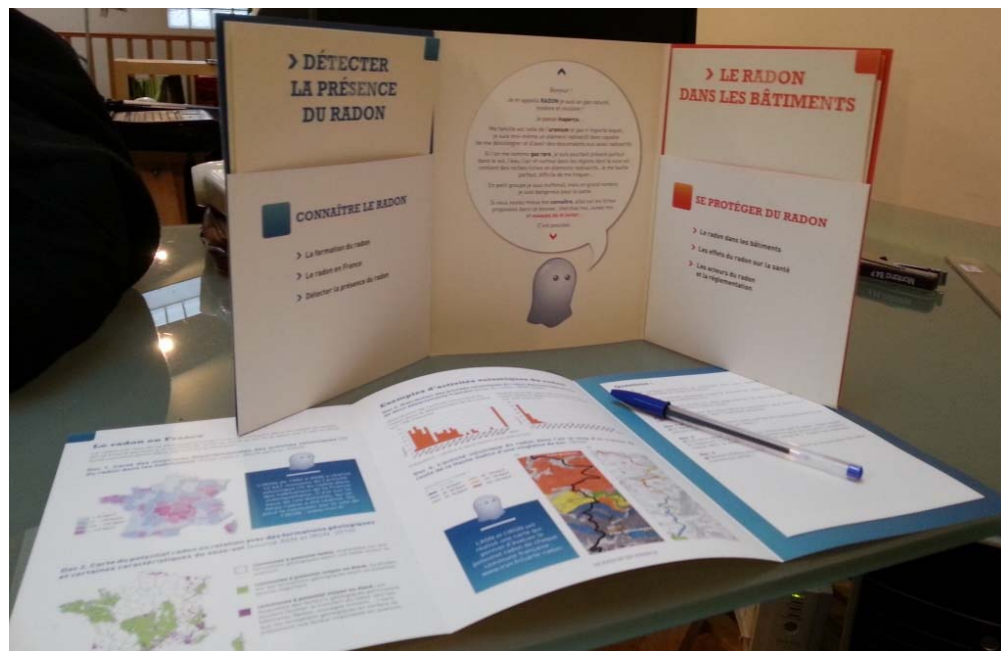
Connaître le radon

- La formation du radon
- Le radon en france
- Détecter la présence du radon

Se protéger du radon

- Le radon dans les bâtiments
- Les effets du radon sur la santé
- Les acteurs du radon et la réglementation





11/14 years old students



Les voies de transfert du radon

Le radon se propage à travers les roches du sous-sol jusqu'au sol par diffusion ou sous l'effet des différences de pression. Il circule plus facilement par les fissures, les failles et les terrains perméables, de qui se situe qu'à leur proximité en surface, la quantité de radon est plus importante.

La demi-vie du radon étant courte (3,8 jours), plus sa circulation dans le sous-sol est facilitée, plus il sera présent en surface. Les grottes, mines et autres cavités souterraines sont autant d'éléments qui facilitent le transport du radon.

Doc 1. Vue en coupe du sol et du sous-sol d'une commune

1. Faille
2. Granite (pluton magmatique)
3. Auréole de roche métamorphique
- 4, 5, 6, 7, 8. Roche sédimentaire (dont l'argile pour la 7)
9. Cavités

Doc 2. Les voies d'entrées du radon dans un bâtiment

1. Fissures
2. Joints entre parois
3. Points de pénétration réseaux
4. Cavités du mur
5. Esau à usage sanitaire
6. Matériaux de construction
7. Air extérieur

Doc 3. Exemple d'évolution de l'activité volumique de radon dans une maison

L'activité d'un corps radioactif se mesure en becquerel (Bq). Un Bq est égal à une désintégration par seconde au sein de ce corps. Exemple : un morceau de granite de 125 g a une activité volumique d'environ 1 000 Bq.

Activité volumique du radon (Bq · m⁻³)

Heure du jour

Questions :

Doc.1

a) Quels sont les trajets possibles de remontée du radon ?

b) Quelles sont les habitations dans lesquelles il y a une probabilité élevée d'avoir une concentration en radon importante ? Pourquoi ?

Doc.2

c) Lister les sources et les voies d'entrées du radon dans la maison.

d) Dans quelle partie d'un bâtiment le radon s'accumule-t-il le plus ? Pourquoi ?

e) A quelle condition l'eau du robinet peut-elle contenir beaucoup de radon ?

Doc.3

f) D'après ce graphique quelle est la solution simple qui permet de réduire l'activité volumique du radon dans une habitation ?

g) Compléter le tableau.

Paramètres	Exemples
1- Capacité des roches à émettre des grandes quantités de radon.	Granite...
2- Capacité du sous-sol à faire transiter le radon rapidement en surface	
3- Facteurs d'accumulation du radon dans les habitations	

h) Compte tenu de notre mode de vie actuel, pourquoi sommes-nous plus exposés au radon aujourd'hui qu'autrefois ?

i) Un bâtiment va être construit sur un terrain riche en uranium. Quelles solutions l'architecte peut-il proposer pour réduire l'entrée du radon dans ce bâtiment ?

Exhibition on Radioactivity

- IRSN & ASN developed 80 kakemonos on ionizing radiation divided in 10 different modules
- Depending on what the teachers want to talk about, they select 25 to 30 from the 80 Kakemonos with the help of a questionnaire the students are invited to find themselves the information on the Kakemonos
- What are the modules :
 - 1-Radioactivity (units, basic knowledge, radon, radioactivity in food (C14 and polonium 210, example of calculation for food), 2-Health aspects, 3- Medical Use, 4-Nuclear Installations and their safety ,5- accidents, 6- Fuel Cycle 7-Waste 8- Radioactivity and Environment

panneau 1



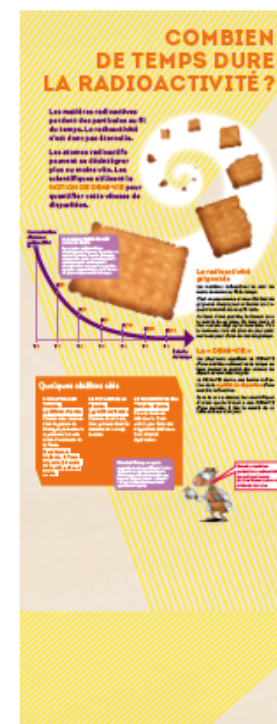
panneau 2



panneau 3



panneau 4



panneau 5



LE RADON EN FRANCE

Cette carte montre les **MESURES MOYENNES** par département de la concentration en radon. Elle s'explique par la nature géologique du sol.

Des mesures variables

Le plateau de la France se caractérise par des reliefs granitiques et les hautes vallées soulignent les fortes concentrations en radon. De plus, dans une même zone, selon la structure des roches, l'aériorité des habitations ou encore la météo, la concentration en radon varie de 10 à 100 fois.

82 départements prioritaires

En France, 82 départements sont prioritaires pour la réduction des risques de radon.

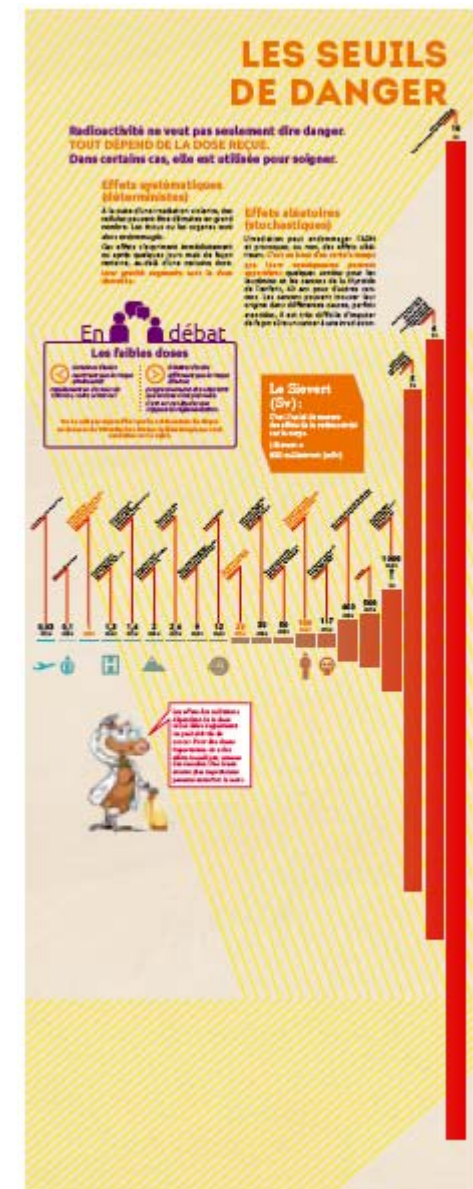


How efficient is it ?

Like their parents, young people prefer the module about the Health Aspects

This year, more than 15 High Schools requested the Exhibition and in depth presentations

IRSN provides Activity Leaders for these presentations (All scientific and technical experts on a voluntary bases)



How to engage students in Measurement activities, Interpretation and Communication

- With the help of measuring device coming from IRSN teachers can give the first basic knowledge on Radon and natural radioactivity, the most interesting phase is when students explain and discuss their results.
- They can make hypothesis on their results and verify them.
- They present their results in front of experts : they can show their creativity in communication.



Lessons learnt

- Ionising radiation and their risks is not a fashionable topic in a normal situation
- It needs interdisciplinary project to have an holistic perspective on ionising radiation, radon or natural radioactivity.
- This topic may scare teachers who don't want to appear as Pro-Nuclear if they speak about radioactivity and Ionising radiation.
- By the experience feedback of the project, that Valéry Bordoïs and his student will explain, IRSN realized that the best way is an interactive interdisciplinary project with student engagement a combination of education and communication



Thank to all the teachers and
students for their outcomes

thank you for your attention