Life after Fukushima workbook

Name:

Class:

Part 1:

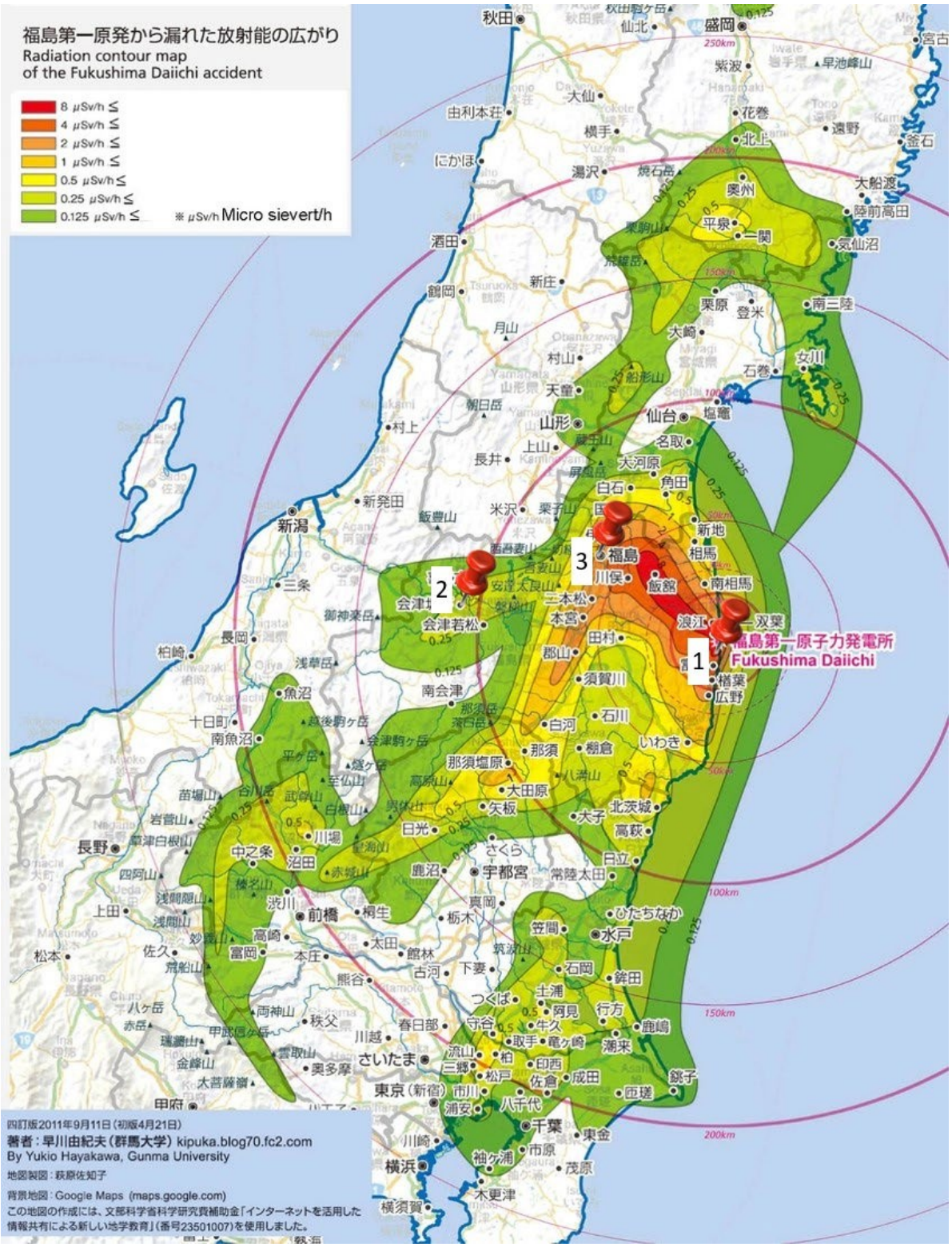
11 March 2011

Contents:

- Indicating on a map the region worst affected by the earthquake and tsunami on 11 March
- Locating the Fukushima Daiichi nuclear power plant in Japan
- Determining the average radiation doses

1. **Indicate the following elements on the map of Japan below:**
    a. The area worst affected by the earthquake of 11 March 2011
    b. The location of the Fukushima Daiichi nuclear power plant

2. **What is the average radiation dose* in Ōkuma (1), Aizu-Wakamatsu (2) and Fukushima town (3)? Indicate the average dose per town. Use the key on the map to determine the dose.**



Ōkuma:
Aizu-Wakamatsu:
Fukushima town:

* Sievert (Sv) is a way of expressing the impact of ionising radiation on, for example, bodily tissue such as organs.

Part 2:

My life after Fukushima

Contents:

1. Radioactivity? I know all about it!

Test your knowledge of radioactivity! Answer the seven questions and then go over the answers. How many points can you get?

1. What is a radionuclide? Choose the correct definition.

	Atoms with an unstable nucleus emitting radiation in the form of waves
	Atoms with an unstable nucleus emitting radiation in the form of particles
	Atoms with an unstable nucleus emitting radiation in the form of particles or waves

2. What types of ionising radiation exist?

	Alpha radiation
	Microwave radiation
	Gamma radiation
	X-rays
	Neutron radiation
	Light
	Beta radiation

3. Choose the statements that are correct.

	The half-life is the time after which exactly half of the original quantity of a substance remains.
	The half-life can vary from a few milliseconds to several minutes.
	Radionuclides cannot split spontaneously.
	Alpha radiation is the easiest type to block.

4. What do the following units express? (Some units have multiple options)

	Activity	Dose equivalent	Collective effective dose	Absorbed dose	Effective dose
Becquerel					
Gray					
Sievert					
Man-sievert					

5. Which type of ionising radiation is easiest to block?

6. Indicate the three basic principles of radiation protection.

	Time
	Protective screens
	Measuring ionising radiation
	The material of the protective screening
	Distance
	Protective clothing

7. Are the following statements true or false?

	True	False
Children and babies are more sensitive to ionising radiation than adults.		
You can only become contaminated externally by radionuclides.		
Some parts of the body are more sensitive to ionising radiation than others.		

2. Radioactivity: what's that?!

Answer the five questions and then go over the answers. How many points can you get?

1. Is ionising radiation visible?

	Yes
	No

2. Indicate whether the following statements about ionising radiation are true or false.

	True	False
Ionising radiation comes from radionuclides.		
All atoms are radionuclides.		
Radionuclides emit enough energy to affect other atoms.		
Ionising radiation cannot damage DNA, the blueprint of our body.		
Ionising radiation is visible.		

3. Which of the following types of radiation are ionising?

	Light
	Alpha radiation
	Microwave radiation
	Gamma radiation
	Beta radiation

4. Indicate which measure gives you sufficient protection against alpha radiation.

	A thick lead sheet
	An aluminium sheet
	Maintaining a distance of 10 cm
	One metre of concrete

5. Indicate what precautions you can take to protect your body from ionising radiation.

	Shielding yourself from radiation
	Moving away from the radioactive source
	Moving the radioactive source
	Measuring the source up close

Transcript: video on radiation protection

Source: SCK CEN (2021), Radiation protection.
Available at: https://vimeo.com/531825298/e6dbcc41bc

Radioactivity is a natural phenomenon. It is present in our own body and also around us in the soil and in the universe. Radioactivity can also be generated artificially. This happens, for example, in a nuclear reactor in order to generate electricity. Radioactive sources are also used in medicine for diagnosis or treatment.

All matter is made up of atoms. Atoms have a nucleus containing protons and neutrons. In a stable nucleus, these particles are in a balanced state. However, in some nuclei, the balance is disrupted. Too much energy makes them unstable. These unstable nuclei can try to get rid of their excess energy by emitting radiation. The different types of radioactive radiation are alpha, beta, gamma, and neutrons. Radioactivity cannot be seen, heard, smelt, tasted or felt. However, it can be measured with suitable measuring equipment. Radioactivity is expressed in becquerels.

Alpha particles are composed of two protons and two neutrons. They are relatively heavy and hold an electrical charge. Alpha particles can easily be blocked. A few centimetres of air or a sheet of paper, for example, are enough to do this. Beta particles are electrons or positrons. They are much lighter and hold less electrical charge than alpha particles. They are also more difficult to shield from. Several metres of air are needed to block beta particles. You could also use between a few millimetres and a few centimetres of aluminium, water, or plastic to shield from beta radiation.

Gamma rays are waves without mass and without any charge. They are very penetrating. In air, gamma rays can travel hundreds of metres without any noticeable loss of energy. Gamma radiation is difficult to shield against. X-rays are also electromagnetic waves, just like gamma rays, but they are usually produced by a generator.

Neutrons are heavy particles without any charge. They are usually formed as a result of nuclear fission or a reaction. They are very penetrating and very difficult to shield against.

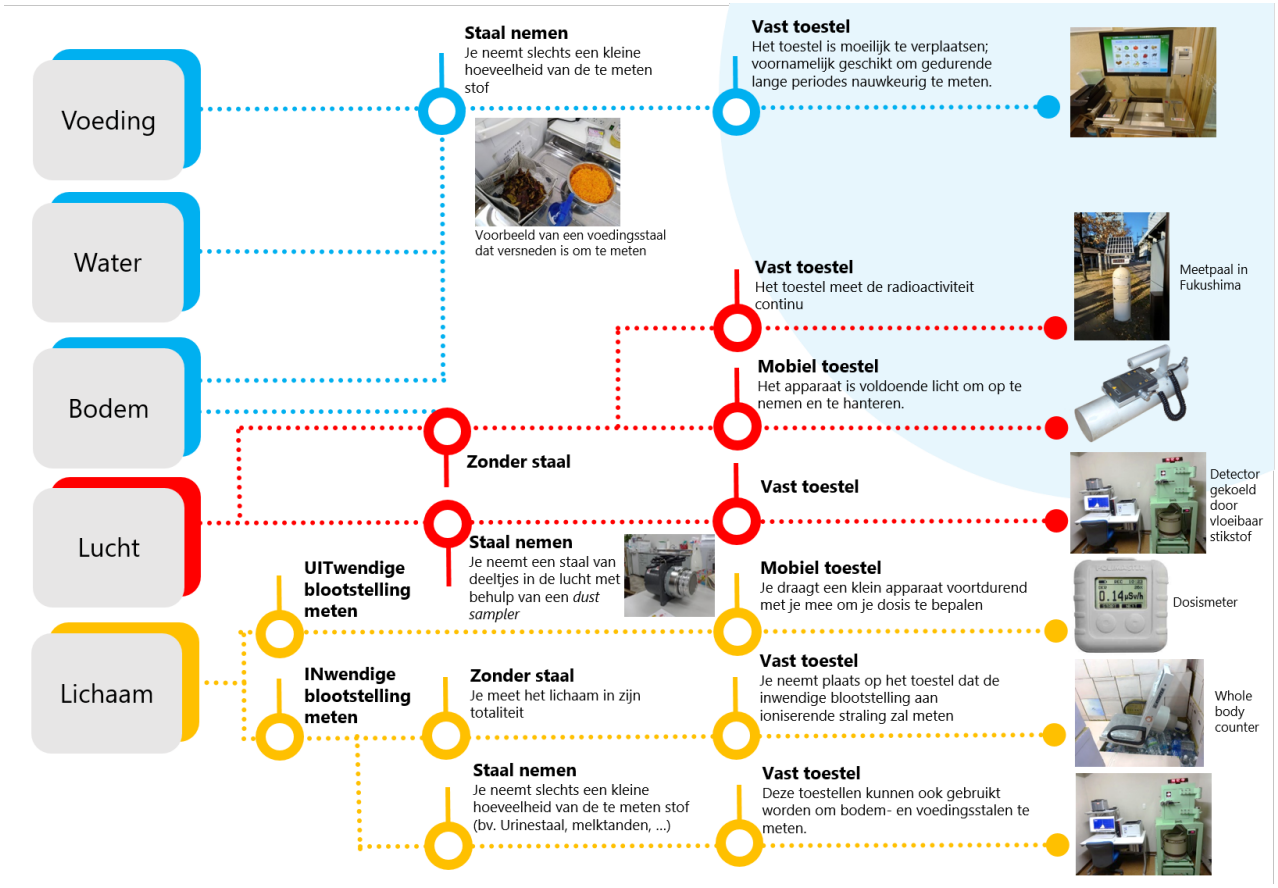
Part 3:

Measuring radiation in a citizens' laboratory

Contents:

1. Which measuring instrument is most suitable for measuring the following aspects? Follow the diagram below and indicate for each aspect whether you need a sample and whether you should use a fixed or mobile device. (Several options may be possible)

What do you want to measure?	Sample required	No sample	Fixed device	Mobile device
Internal exposure in the body (whole body)				
Vegetables from the garden				
Seawater				
Average dose in the playground				



2. Go to the interview with Kaori Suzuki, one of the founders of the citizens' lab TARACHINE in Iwaki (Greenpeace, 2021).

The interview can be found at the following link:
https://fukushimatestimony.jp/en/live/7.html.

View the article and read it carefully. Then answer the following questions:

1. **What activities does TARACHINE organise?**

	True	False
Measuring radioactivity		
Medical activities (thyroid screening, etc.)		
Mental health counselling		
Info sessions and other informative events		
Organising study groups		

2. **Who works in TARACHINE?**

3. **How much does it cost to have a sample measured by TARACHINE?**

	2000 yen
	20,000 yen
	500 yen
	nothing

4. **What does Kaori Suzuki mean by "What we eat should be a matter of choice"? Explain this in your own words.**

_____
_____
_____
_____

5. **At the end of the interview, you will find the following quote. Who or what is the "Establishment"?**
"If we knew as much straight after the accident as we do now," reflects Suzuki, "we would have been able to avoid a lot of unnecessary exposure. In the beginning, all we were doing at TARACHINE was stepping up to provide a service where we felt the establishment was failing. Now we also want to stress the importance of everyday citizens arming themselves with scientific knowledge."

_____

Why does Kaori Suzuki think it is important for "*citizens to arm themselves with scientific knowledge*"?

_____
_____
_____
_____
_____

6. **Do you think TARACHINE is a form of citizen science? Provide some arguments to support your opinion. Use the information you can find online or in the Prezi presentation.**

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_____
_____
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INTERVIEW MET KAORI SUZUKI

Source: Greenpeace Japan (2021). Lives of Fukushima - Profile: Kaori Suzuki.
Available at: https://fukushimatestimony.jp/en/live/7.html

Transcript (English)

"I look at children and young adults, and it reminds me that there are babies still being born today who will carry the burden of decommissioning in the future, all because of a radiological accident that had nothing to do with them. The adults of our generation need to be more aware of this."

Profile *Kaori Suzuki*

Kaori Suzuki was one of a group of local mothers who set up the "Iwaki Citizens' Radiation Measurement Centre - TARACHINE" in her hometown of Iwaki, Fukushima prefecture, back in November 2011. Taking their name from a traditional word for "mother", their initial goal was to shield children from radiation exposure following the disaster at Fukushima Daiichi. TARACHINE carry out measurements on food, soil, and other environmental samples brought in by the general public, as well as providing thyroid screenings and whole body exposure testing.

The Iwaki Citizens' Radiation Measurement Centre - TARACHINE" (hereafter "TARACHINE" for short) has caught the attention of individuals and organisations not only in Japan but worldwide. Although hard to imagine, in less than ten years the non-profit group has grown from a small effort started by three local mothers into a professional operation with its own testing laboratory and clinic. TARACHINE now employs 15 full-time staff – 13 women and 2 men, but is still run by neighbourhood mothers.

From humble beginnings to a "citizens' science" movement

"Back when we started, our biggest concern was whether or not our food was safe to eat. But at that time, we had no access to professionals who were prepared to come to Fukushima to take these sort of measurements. If we wanted to protect our children, we felt we had no option but to do the job ourselves."

Kaori Suzuki recalls the early days of TARACHINE back in 2011, when she served as administrative director.

After establishing TARACHINE, the team had to do their own research and teach themselves how to take accurate measurements. In 2014, they brought in a state-of-the-art beta ray detector that demanded a high level of expertise, considered difficult to use even by seasoned analysts. Their skills grew by the day with the help of professional scientists who, impressed by the hard work of the TARACHINE mothers, provided support and training. As mothers proficient at running households, they were quick to pick up the precise tasks of preparing and measuring samples. In order to offer reliability and precision, they assembled a collection of top-quality instrumentation covering everything from measuring scales to radiation detectors. They made sure their results could be relied on by cross checking with third party laboratories as needed.

TARACHINE is the only private-sector laboratory in Japan capable of testing for beta-emitting radionuclides such as strontium 90 and tritium in addition to caesium. For Suzuki, providing strontium testing was not a difficult decision, as its long half-life allows it to build up in the skeleton. Through their online and offline activities, the group raised awareness of their vital work, an approach that enabled them to attract strong financial backing from both within Japan and overseas. Ultimately, this led to the TARACHINE team being able to purchase the beta ray detector, a piece of equipment that would normally be well beyond the means of everyday citizens. Everything the group does shares a common goal: ascertaining the reality of radioactive contamination from Fukushima Daiichi, and reducing the exposure risk to their children.

When public fear of radiation was at its highest back in 2011 and 2012, citizen-run testing centres began appearing all over Japan. Most of these centres charged measurement fees of a few thousand yen (about USD 20–30) in order to stay in operation. However, TARACHINE adopted a different model, aiming to keep fees within reach of ordinary citizens. Initially they charged only 500 yen (about 5 USD) per measurement, and nowadays, they will test free of charge in principle.

TARACHINE's running costs are covered by support groups and donations from the general public. Things were not easy in the beginning – due to the almost complete lack of testing revenue, in 2012 TARACHINE found themselves facing bankruptcy. This led to a desperate campaign to secure funding, a strategy which, as Suzuki explains, eventually led to solid financial backing that has allowed them to continue operating.

"Since 94% of our running costs are covered by donations from the general public, we in turn take our obligation to share our work very seriously. Right from the beginning, we have used our website to fully disclose our activities, including monthly summaries of measurement results. When we can, we also upload information in English since this is an issue that goes beyond Japan."

TARACHINE's continued reporting and transparency have earned them respect and support, and their operations are now enabled by a strong support base spanning both generations and national borders.

What we eat should be a matter of choice

The majority of TARACHINE's work revolves around testing food destined for home consumption. Requests for soil testing (samples from agricultural land, garden vegetable patches, and the sandpits of children's playgrounds) are also common. Although happy to accept requests from both inside and outside Fukushima prefecture, most come from in and around the town of Iwaki. In the early years, TARACHINE processed around 300 samples every month. Even though this number has dropped by half in the last few years, TARACHINE's equipment is still running at capacity year-round.

Around the middle of 2013, the levels of caesium-134 being detected dropped away as the two-year half-life of this isotope came and went. However, mushrooms and other edible plants gathered from the wild continue to give high readings. Another concerning development is that pinecones, acorns, and other natural objects that children like to pick up and play with still contain detectable amounts of radioactive isotopes. Similarly, some soil samples continue to give positive readings*. Many people also ask TARACHINE to test the fluff from their vacuum cleaner bags and appliance filters in order to find out the level of contamination in their homes. This sometimes reveals contamination that spreads around the home through floating dust particles.

"When we test a sample, we provide the results not only to the client but also share them online. The government tells us that anything up to 100 Bq/kg (Becquerel per kilogram) is safe to eat. At TARACHINE, we don't give a cut-off point for what is or isn't safe. As the victims of this disaster, in the same way that we should have the freedom to choose whether or not we want to continue living in the disaster area, we believe that what we do or don't eat is also a matter of personal choice. Instead of simply repeating the government advice, we also share information from consumer cooperatives, overseas authorities, and so on. Beyond that, it is a matter for the individual to decide."

Damage to the rural way of life

Although, in principle, TARACHINE provides its services to household consumers, they will also test samples of agricultural produce and soil brought in by commercial farmers. In particular, many farmers want the peace of mind of knowing their soil is safe before planting out.

"Farmers don't want to sell their produce if they think it might be contaminated. Back in 2012 and 2013, locally produced rice showed levels of radioactive contamination. Naturally, parents didn't want this rice to be fed to their children in school meals, but what was striking was that even the rice farmers themselves joined in to put pressure on the local authority. It shows the pride they take in their role as food producers. For me, this really drives home our own responsibility in the role of data handlers."

In rural food-producing communities, the giving and receiving of homegrown produce is a key part of day-to-day social interactions. For this reason, Suzuki finds it especially poignant whenever a client asks her to test food they intend to give to a neighbour, or food that they have received themselves. Even the traditional social ties of the rural community have been tainted by the fear of contamination.

Keeping sight of the original goal

Around five years after the Fukushima Daiichi disaster, Suzuki was struck by how many parents were still unable to shake off their fears for their children's health. This led TARACHINE down the path to providing clinical examinations as well as consultations on physical and mental wellbeing. From its early days, TARACHINE has been offering thyroid inspections and radiation exposure testing using a whole body counter. However, Suzuki came to realise the importance of providing psychological care at the same time.

In 2016, TARACHINE took steps toward opening its own clinic and hiring a doctor. They found the money through a combination of donations, grants, and crowdfunding. The following year, Japan's first citizen-led testing centre-affiliated clinic opened its doors.

"There wasn't really anywhere in Fukushima where you could get a test whenever you wanted, or discuss your concerns about radiation freely with a medical professional. In the case of the Chernobyl disaster, we know that children started to

develop thyroid cancers and other illnesses about five years after the radiation leak. Considering that timeline, we felt we had an obligation to provide this service."

In the case of Fukushima, it is not so much actual symptoms as the anxiety and uncertainty surrounding possible complications that has weighed most heavily on the population. The ability to speak to a medical professional gives concerned parents and their children access to a balanced understanding of the risks, and this in turn serves as a form of psychological support. TARACHINE provides thyroid screenings free of charge to anyone who was a child up to high school age at the time of the accident, whilst full body radiation measurements are available for free to anyone up to the age of eighteen.

As part of TARACHINE's evolution to accommodate the needs of children and their guardians, they have begun hosting events to disseminate knowledge about the nuclear industry and radiation. Recent events have provided a space to gain a deeper insight into the "Fukushima Innovation Coast Framework", a recovery-focused scheme that is being promoted in the Hamadori (coastal) area of Fukushima prefecture.

"One part of the recovery plan is a fabulous school, to be built close to the 'difficult-to-return' contaminated zone to try and tempt more children back to the area. It's made to sound like a fantastic opportunity, and the region is awash with money shelled out in the name of 'recovery'. People have concerns that some questionable schemes might be seeking to exploit the tenth anniversary of the disaster, and it's important that we keep a close eye on what's happening."

TARACHINE was born out of providing support and trying to alleviate citizens' concerns. From radiation testing and clinical screening, the project has grown to encompass mental wellbeing and study groups. But everything shares a common thread, namely trying to improve the health and livelihood of the people affected by the disaster.

The role of Fukushima and the adults' responsibilities

The past five years have seen an increase in requests for full-body radiation screenings from workers who were involved in decontamination efforts in heavily contaminated areas of Futaba district. Young men in their twenties are especially prevalent, explains Suzuki.

“I look at children and young adults, and it reminds me that there are babies still being born today who will carry the burden of decommissioning in the future, all because of a radiological accident that had nothing to do with them. Even the generation born after that will still be working on the Fukushima Daiichi cleanup. Once you start thinking like that, it's hard to feel optimistic. I think the adults of our generation need to be more aware of this.”

TARACHINE started from a simple concern – “Will our dinner tonight be safe to eat?” The group has grown organically from these humble beginnings, and increasingly finds itself in the role of educator, seeking to spread the message of the reality of life in Fukushima to other regions – and to future generations.

"If we knew as much straight after the accident as we do now," reflects Suzuki, "we would have been able to avoid a lot of unnecessary exposure. In the beginning, all we were doing at TARACHINE was stepping up to provide a service where we felt the establishment was failing. Now we also want to stress the importance of everyday citizens arming themselves with scientific knowledge."

The radiological accident has brought in its wake new fears and new tasks – testing of schoolyard and garden soil, regular health checkups, recuperation in uncontaminated areas, as well as psychological care for exhausted parents.

"We need the world to understand how the reality of daily life has changed for anyone bringing up a child in Fukushima. It's imperative that the same thing never be inflicted on another community. As the people living every day in this new 'post-Fukushima' reality, I think us Fukushima citizens have a duty to speak up and share our experiences."

*Around 70% of the samples tested by TARACHINE are of soil and food products. As of the end of April 2017, around 30% of these samples showed detectable amounts of radioactive contamination. The lower detectable limit varies depending on equipment and method.

PART 4:

Fukushima and Belgium

Contents:

- Protecting yourself in the event of a nuclear accident
- The TELERAD network
- What have you learned?

1. **Do you know what to do in the event of a nuclear accident?**

   Watch the following clip and then answer the question below:
   https://www.youtube.com/watch?v=xftWQZbTT0k.

   Identify the best measures to take in the event of a nuclear accident.

	Running away
	Sheltering
	Opening windows
	Closing windows
	Following government recommendations via the news or other channels
	Switching off ventilation and air conditioning systems
	Switching on ventilation and air conditioning systems

2. Go to the TELERAD network website via this link:
   https://telerad.fgov.be/Html5Viewer/index.html?viewer=telerad_nl

   Search for your town on the map. Then find the measuring station closest to where you live. Write down the location of that measuring station below.

   _____

   Compare the measured value from that measuring station with that of the measuring station at Fukushima train station. Use the following websites for to make this comparison:

   - SAFECAST: https://map.safecast.org/
   - Japanese government :
     https://ramap.jmc.or.jp/map/eng/#lat=37.434239832898626&lon=140.97587222374597&z=10&b=std&t=soil&s=13,0,1,0&c=20120425_dr,20171001earth_dr

   Write down the values you found below:

   - SAFECAST website:
   - Japanese government:

3. **What will you take away from this lesson about Fukushima?**

You may wish to add additional questions or suggestions to encourage class discussions in relation to the four themes.

- **Chapter 1:** How to prepare a society for a natural disaster, what would you miss the most if you had to evacuate from your hometown?
- **Chapter 2:** In your own words, explain how the nuclear disaster affected the daily lives of Masako and her family
- **Chapter 3:** Do you think it is important for citizens to be able to measure radioactivity themselves? Why? Would you also take measurements if there were a nuclear disaster in Belgium or elsewhere in Europe?
- **Chapter 4:** you have used several sources of information to look up measurement values (a Belgian and Japanese government source and an independent source). What is your impression of the different sources? Do you think it is important to consult a mix of independent and government sources during a (nuclear) disaster? Explain why or why not.

Transcript: Do you know what to do in the event of a nuclear accident?

Source: RiskinfoBE (2016). Do you know what to do in the event of a nuclear accident
Available at: https://www.youtube.com/watch?v=xftWQZbTT0k

Do you know what to do in the event of a nuclear accident? If something goes wrong in a nuclear power plant, various safety mechanisms come into play. In the worst case, radioactivity will have escaped from a nuclear power plant for a certain period of time. This forms a cloud of radioactive particles that you cannot see, feel, taste or smell. This cloud is blown along by the wind. Some of these radioactive particles swirl down from the cloud to the ground. Anyone outside at this point is at risk of being irradiated or contaminated by inhaling particles or by particles landing on skin or clothing. This is why sheltering is the best way to protect yourself. It reduces the risk of irradiation or contamination by 80%. So you should go inside the nearest building. Stay inside until you get word that it's safe again. Close all windows doors and turn off all ventilation, heating, and air conditioning systems. Inform yourself about the right measures via BE-Alert, radio, TV, the official websites and the government social media channels. They will give you information about taking iodine tablets and will tell you when you can leave your house. The three steps to take in a nuclear accident. Find out more at nucleairrisico.be.