



**HOKKAIDO**  
UNIVERSITY

# **Nuclear Education Programmes Being Developed at Hokkaido University**

**Utilizing Open Courseware**

**July 19, 2022**

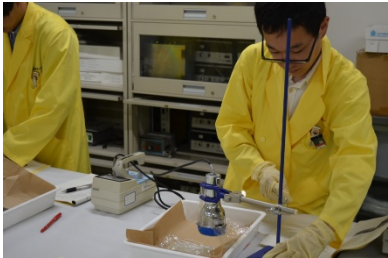
**Naoko Watanabe, Tamotsu Kozaki**  
**Division of Applied Quantum Science and Engineering**

**Hiroshi Nakashima**  
**Center of Ambitious Research and Education for Nuclear Safety**

# Educational Training Program for Experts in the Backend Field

## Lab/Field Training

### Lab training



### Field training (Kawauchi Village)



### Site Tour (Horonobe Underground Research Center/JAEA)



## International Activities

### International seminar



### Discussion



### Overseas Internship



## Open Courseware

Digital learning materials that are **free, openly licensed, and accessible to anyone anytime** via the internet

Training experts in the backend field

<https://www.open-ed.hokudai.ac.jp/nucl-eng-edu-archives/>



# MOOC(Massive Open Online Courses) Aimed at Increasing Public Awareness



edX HOW IT WORKS COURSES SCHOOLS & PARTNERS Search for course

**Effects of Radiation: An Introduction to Radiation and Radioactivity**

Learn from Hokkaido University in Japan about the detection, measurement, chemistry, and effects of radiation in industry, medicine, and society.

OPEN EDUCATION  
FOR ALL

<https://www.edx.org/course/effects-of-radiation-an-introduction-to-radiation>

## Effects of Radiation: Introduction to Radiation and Radioactivity

-From basic science to application in  
modern society-

- Date: July-Aug. 2015
- Registration: 4,342 (Country: 133)
- Number of Access: 1,385
- Certificate of achievement: 380



gacco 無料く学べるオンライン講座 受講料が0円から受講！

講座一覧 受講ガイド マイページ/ログイン 会員登録 (無料)

講座一覧

あなたの学びたい気持ちに応える講座がたくさん。  
さあ、いまずく受講登録しよう！

新規受付を終了した講座 次回受講をお待ちください

**放射線・放射能の科学** 2020年3月12日 開講  
北海道大学 受講期間：5週間 終了

放射線・放射能について物理的な基礎知識、放射線検出・測定、人体への影響、医学や原子力発電を合わせた工学分野・農業への応用、放射性廃棄物の処理・処分方法を学びます

講義詳細を見る

[https://lms.gacco.org/courses/course-v1:gacco+ga140+2020\\_03/about](https://lms.gacco.org/courses/course-v1:gacco+ga140+2020_03/about)

## Science of Radiation and Radio- activity (in Japanese)

- Date: Mar. -May 2020,  
Feb.-May 2021
- Registration: **3,688**
- Number of Access: 1,063
- Certificate of achievement: 585

## Questionnaire respondents

Full-time worker:	50.0%(850/1699)
Part-time worker:	9.2%(156/1699)
Unemployed:	21.2%(361/1699)
Elementary - high school:	2.2%( 38/1699)
University student:	11.1%(188/1699)
Master course student:	1.4%( 23/1699)
Doctoral course:	0.5%( 9/1699)



# Expanding: Covering All Fields in Nuclear Engineering in the Framework of ANEC

## Hokkaido University



<https://ocw.hokudai.ac.jp/?l=en>

## Open Courseware in Nuclear Engineering

- Total releases: 100 contents
- Total views: 80,000
- Fields: radiation, nuclear reactor physics, decommissioning, waste management, etc.

## Developing in the framework of ANEC



## Expanding and Building New Courseware:

- cover a wider range of fields in nuclear engineering
- systematic contents targeted at different age groups
- improvement based on the feedback from students



# Appendix



# Using "Shin-Godzilla" as Material for OER-based Course Development

Kazuya Kobayashi, Hiroaki Tanaka, Katsusuke Shigeta, Keiko Suzuki, Richard Stone Hokkaido University, Center for Open Education  
Tamotsu Kozaki, Naoko Watanabe Hokkaido University, Faculty of Engineering

"Shin-Godzilla" is a monster created by radiation



- Using the movie *Shin Godzilla* as a resource helped provide a **common theme** to the curriculum of this Omnibus course.
- Being able to critique a work of fiction from an **engineer's viewpoint** helped make the course appealing to both science and humanities students and faculty.
- In class, students were able to practice **"thinking like engineers."** Students gradually worked to realize the fruits of their training in the final presentation.

2011

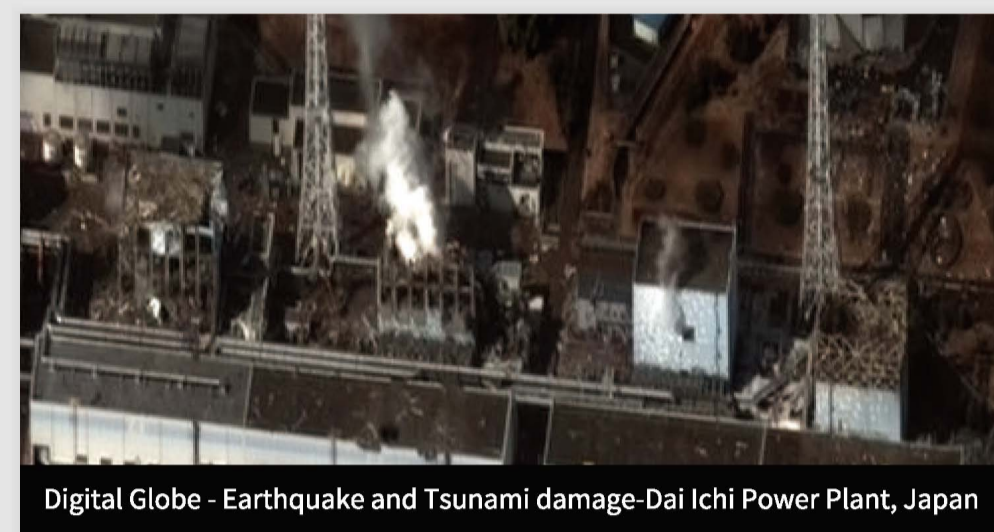
2013

2015

2016 - 2019

## Fukushima Incident

Increased Interest in Radiation and Radioactivity



## Developing OER for OpenCourseWare

The Hokkaido University Faculty of Engineering began developing OER to help teach the basics of radiation and radioactivity – Broadcasted on Hokkaido University OpenCourseWare (OCW).



## Developing OER for MOOC

The course "Effects of Radiation" was released on edX (improvements include: the application of instructional design, the addition of supplementary content as needed, etc.)



## On-Campus Use in "Flipped Classrooms"

Students would prepare using the OER produced for the edX course before class. Using the online learning platform ACE, students could watch both the videos made as OER and previous lectures. In class, students used 'PBL' to think through issues.



# 2016-2019 The Development of a New Curriculum

## Challenges

### General education

Because the class was offered to students from both the humanities and the sciences, there was no guarantee that all participants would have even a basic grasp of Physics.

### Motivation

It was necessary to help students acquire the necessary basic knowledge while still increasing their motivation to participate in the class.

### After Fukushima

It was necessary to think about how to create a course on radioactivity and radiation that could appeal to students after the disaster that had occurred in Fukushima.

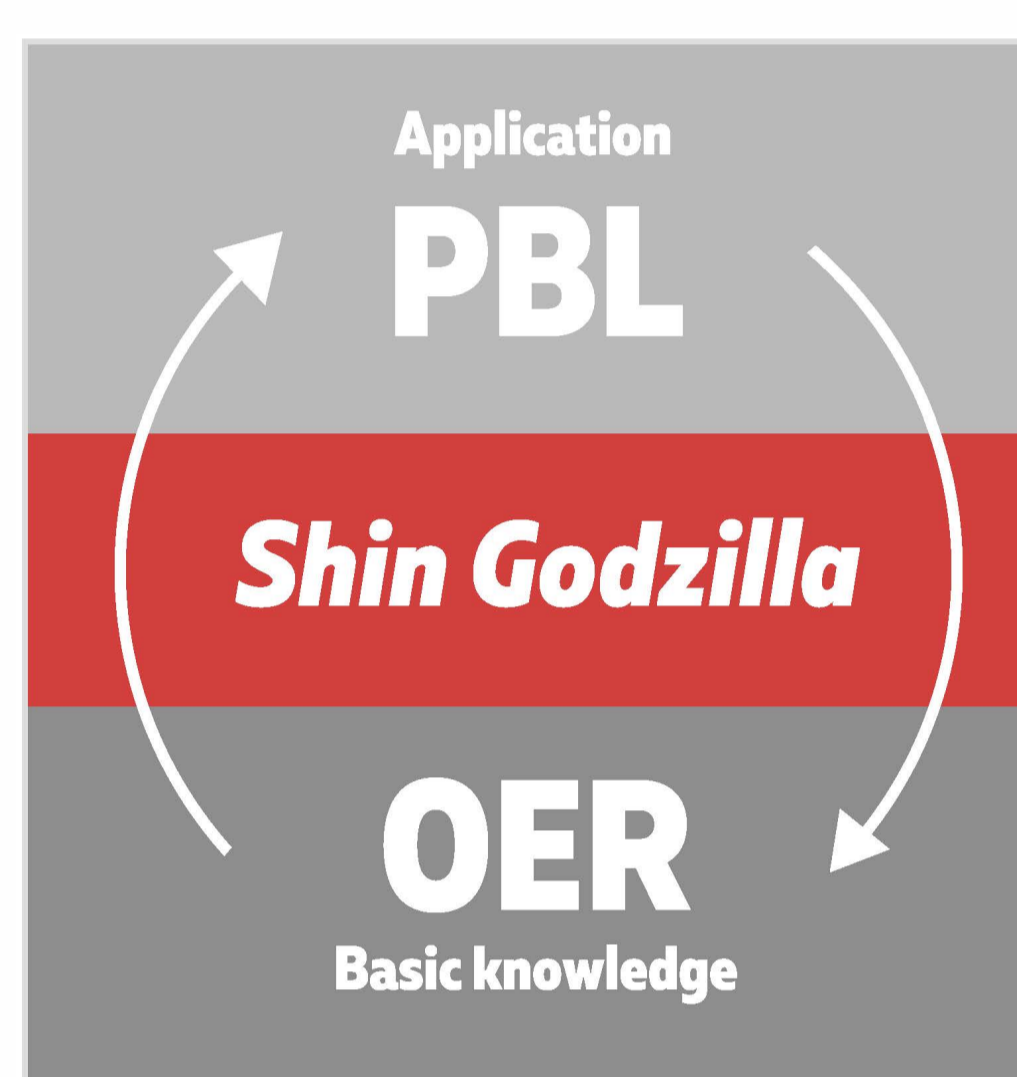
## Solutions

### Using *Shin Godzilla*

Using the movie *Shin Godzilla* as the course theme as an example that depicts how modern Japanese society would respond when faced with a monster (*Kaiju*, 怪獣) that emits radiation.



Instead of merely trivializing complex problems from the real world, instructors are able to create class assignments using a fictional object. This helps the instructors adjust the level of difficulty of these assignments, which in turn makes it possible to create problems for students who are not used to making calculations in physics.



## Course Development through Practice

The theme of *Shin Godzilla* was provided to help course instructors utilize OER and effectively develop a class on radiation. Here, you can see an example of how this theme helped students learn about radiation and radioactivity.

## PBL Example

Out of the following options, which would be the one which offers the lowest exposure to *Godzilla's* radiation? Assume that *Godzilla* is 1 km away and has a radiation dose rate of 1 mSv/h.



### 1 Evacuate below ground:

Distance of 0.1 km; 1 meter thick concrete barrier between you and *Godzilla*.

$$1 \text{ mSv/h} \div (0.1)^2 \times (4.14 \times 10^{-8}) = 4.14 \times 10^{-6} \text{ mSv/h} = 0.004 \mu\text{Sv/h}$$

### 2 Just run away!:

Distance of 2 km.

$$1 \text{ mSv/h} \div 2^2 = 0.25 \text{ mSv/h}$$

### 3 Hide inside of a car:

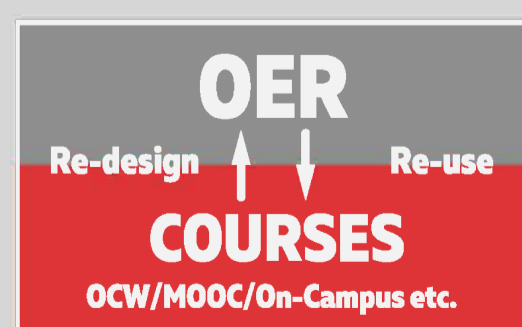
Distance of 1 km; steel plate barrier between you and *Godzilla*

$$1 \text{ mSv/h} \times (0.74) = 0.74 \text{ mSv/h}$$

Instructor	OER (e-learning)	PBL
Ryoko Fujiyoshi	<b>Atoms and Radiation</b> What are atoms? Atomic nuclei? Radiation? Introduction to the different types of radiation and their penetrating power. <b>Radionuclides and Radioactive decay</b> Radionuclides, radioactive decay, and measuring radioactive decay	<b>Thinking about <i>Godzilla's</i> elemental composition</b> L Explaining the concept of <i>Godzillalysis</i> P Considering how much of <i>Godzilla</i> is made up of metals by determining density through height and weight
Takashi Kamiyama	<b>Interaction between Radiation and Matter</b> Basic introduction to interactions between radiation and matter Heavy charged particles, X-rays, γ-rays, neutron-rays	<b>Approaching the mystery of <i>Godzilla</i></b> L OER review, analyzing the <i>Godzilla</i> Beam in the movie P Calculating the range of radiation
Tamotsu Kozaki	<b>Radiation Measurement Basics 1</b> Basics of radiation measurement, The Geiger-meter and its functions, how to use a survey meter	<b>Thinking critically about radiation measurements and detection in the movie <i>Shin Godzilla</i></b> L OER review, how to infer material from the energy spectrum P Experiment with survey meters, inferring material from energy spectrum
Junichi H. Kaneko	<b>Radiation Measurement Basics 2</b> Types of Radiation Measurement and their Principles, Scintillation Detectors	<b>Learning about air dose rates/field trip to storage facility</b> L What does the term "Air Dose Rate" mean? P Thinking about <i>Godzilla's</i> shielding capability in order to measure energy distribution from the gamma-rays he emits
Tohru Yamamori	<b>Effects of Radiation on the Human Body</b> Types of radiation exposure and radiation hazards Deterministic effects and probable effects (e.g., cancer, genetic effects)	<b>Thinking about <i>Godzilla</i> in terms of radiation prevention</b> L The basics of radiation prevention, effective half-life and biological half-life P How much radiation are we exposed to when we approach <i>Godzilla</i> ? How long can you be near <i>Godzilla</i> without sustaining serious damages?
Go Chiba	<b>Use of Radiation 1: Nuclear Reactor Mechanisms</b> Fission reactions/fission chain reactions, mechanisms and components of nuclear reactors, light water reactors.	<b>Considering the mechanisms of <i>Godzilla's</i> energy source and the new elements created by <i>Godzilla</i></b> L Bonding energy of nuclides and nuclear fusion/fission P Thinking about where the new elements in the movie would be on the chart of nuclides
Hiroataka Sato	<b>Use of Radiation 2</b> Industrial, Agricultural, and Medical Applications of Radiation Characteristics of applying radiation: penetration, scattering, and absorption	<b>How could we make a Mecha-<i>Godzilla</i> that can stand up to <i>Godzilla</i>?</b> L/P Penetration: Considering a Mecha- <i>Godzilla</i> -Eye that could see into <i>Godzilla's</i> insides Scattering: How can we make a Mecha- <i>Godzilla</i> Beam that could make <i>Godzilla</i> retreat? Absorption: Is it possible to absorb the <i>Godzilla</i> Beam and turn it into our own energy?
Naoko Watanabe	<b>Environmental Radioactivity in Fukushima</b> Introduction of the data obtained by Hokkaido University's research group on decontamination efforts Environmental contamination, migration of Cesium in the environment, behavior of radioactive cesium	<b>How could <i>Godzilla</i> be disposed of as a form of nuclear waste</b> L Methods of disposing of nuclear waste, nuclear decommissioning P How to dissect <i>Godzilla</i> as a form of nuclear waste?

## OER Use and Improvement

- The use of *Godzilla* in this course has also helped make the class appealing to students and has led to high course evaluations.
- By using a fictional work as course material, students were able to better learn how to use the scientific knowledge they had already acquired to form hypotheses.
- Improvements are continuously being made to the course based on student feedback concerning the course and the educational materials used.  
Improvements include re-editing preparatory educational resources, changes to course content from the instructors, and changes to how group-work is conducted.



## Peer-Evaluation

Students evaluated one another based on whether their peers had correctly utilized their knowledge of radiation and radioactivity.

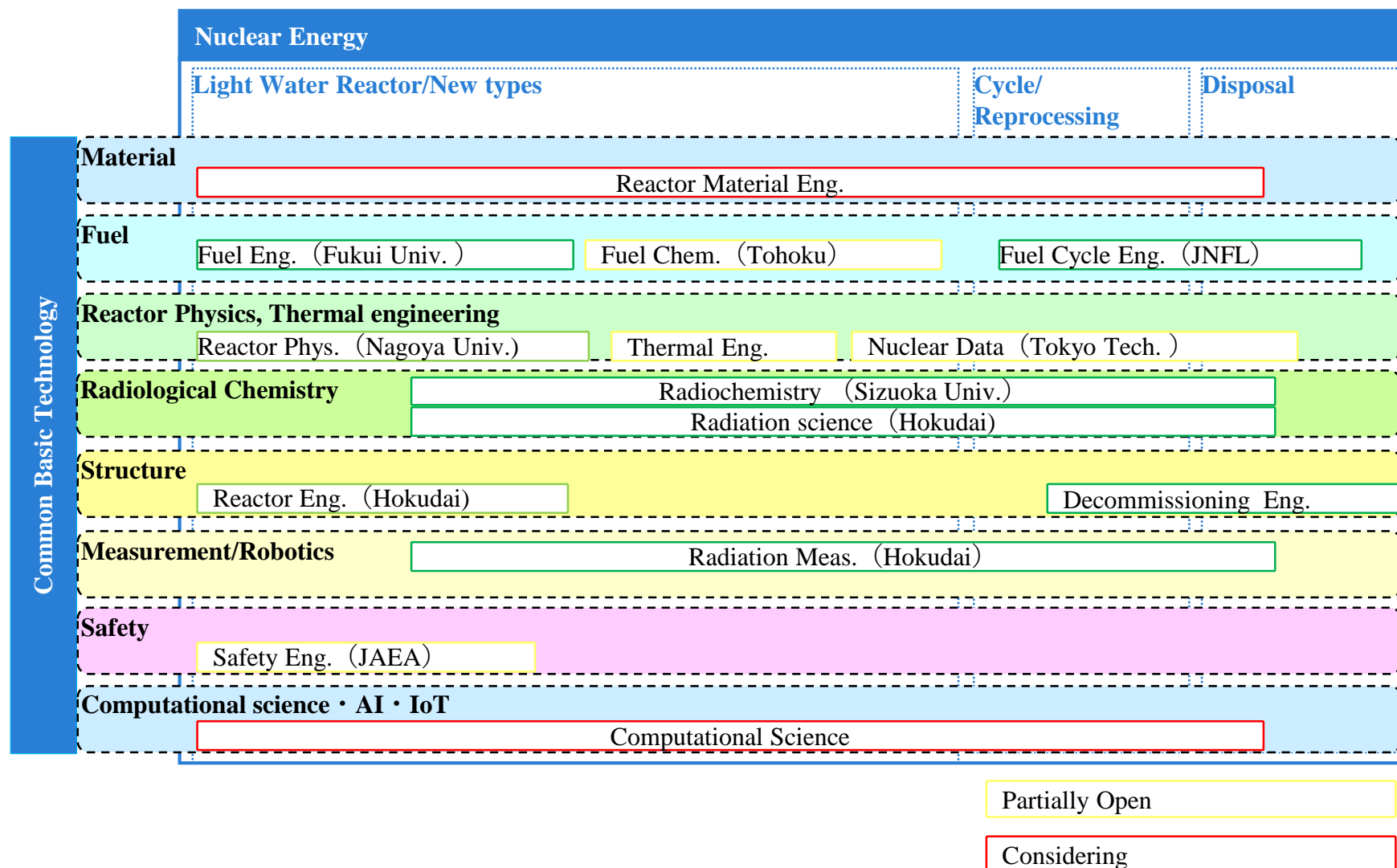


## Next Steps

- We are aiming to achieve a cycle in which continually using OER, both on-campus and in MOOCs, gives us more feedback for further improvements.
- We will be aiming to offer a MOOC on the subject of radiation and radioactivity domestically in Japan in the future as well.

These activities have been performed in part within the Japanese Ministry of Education, Culture, Sports, Science and Technology's project; Nuclear Power Training and Education Support Program (Nuclear Education and Research Initiative). We would like to express our gratitude for the support we have received from them here.

# Opened and planned curriculum with open online resources





**HOKKAIDO**  
UNIVERSITY

# Establishment of Nuclear Education Support System at Hokkaido University

July 19, 2022

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Division of Applied Quantum Science and Engineering

**Hiroshi Nakashima**  
Center of Ambitious Research and Education for Nuclear Safety

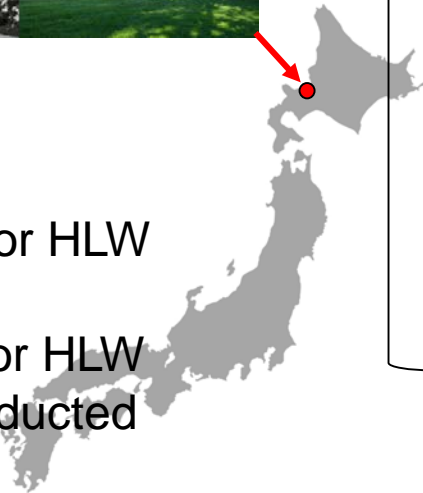


# Nuclear education support system at Hokkaido University



Hokkaido Pref.

- 3 Nuclear Power reactors
- Underground research laboratory for HLW disposal
- 2 areas in which literature survey for HLW disposal site selection is being conducted



- Central Institute of Isotope Science
- **Center for Open Education**
- Graduate School of Biomedical Science and Engineering
- **Undergraduate / Graduate Schools of Engineering**
  - Department of Mechanical and Intelligent system Eng.
  - Division of Quantum Science and Eng.
  - Division of Energy and Environmental Systems
  - **Endowed Chair (Laboratory of Nuclear Power Infrastructure and Technologies)**
  - **Center of Ambitious Research and Education for Nuclear Safety**



## Nuclear education supported with OEC (Open Education Center)

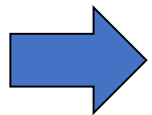


北海道大学  
オープンエデュケーション  
センター  
CENTER FOR OPEN EDUCATION  
HOKKAIDO UNIVERSITY

The Center for Open Education, Hokkaido University was established in April 2014 to support education and learning using ICT and to promote research and development related to OER (Open Education Resources).

(3 Professors, 7 staffs)

- Development and release of Open Course Ware (>2,000 contents, >150,000 accesses)
- Implemented learning support using Open Course Ware (> 230 lectures)
- Development and release of MOOC (>10,000 participants)



### For Nuclear Education

- Open Course Ware (> 100 contents, >90,000 accesses)
- MOOC (Effects of radiation, in English and Japanese)
- Course Development based on OCW
- Collaboration for Nuclear Education and Research Initiative (MEXT program)



## Faculty of Engineering

Division of Applied Quantum Science and Engineering

Established in Oct., 2021

**Center of Ambitious Research and Education for Nuclear Safety**

Established in Mar., 2017

**Endowed Chair**  
(Laboratory of Nuclear Power Infrastructure and Technologies)



- Promote Nuclear Education and Research Initiative (MEXT program)
  - Specially Appointed Professor, H. Nakashima, manages the educational programs in Hokkaido Univ., and also works for ANEC as manager.

Donation  
Lectures  
Internship

Recurrent program  
Doctoral program  
Joint research

