

**TTWS2021JPN-RP,
Training Trainers Workshop, 2021, Japan**



IAEA RAS0079TCP,
Educating Secondary Students and Science Teachers
on Nuclear Science and Technology,

**Virtual Regional Training Course
on NST specialized Programme
in the Field of Radiation Protection**

5 August – 1 September 2021



Hosted by

Science and Technology
Information Forum(STIF), Japan

Supported by

The University of Tokyo
(Div. for EHS, UTokyo)

Lecture **1**
Basic

RP as a secondary teaching theme: its wide scope and infinite possibility



Takeshi IIMOTO

Professor / PhD

Division for Environment, Health and Safety, The University of Tokyo

<http://iimoto-kankyoanzen.adm.u-tokyo.ac.jp/>

Scope Keywords

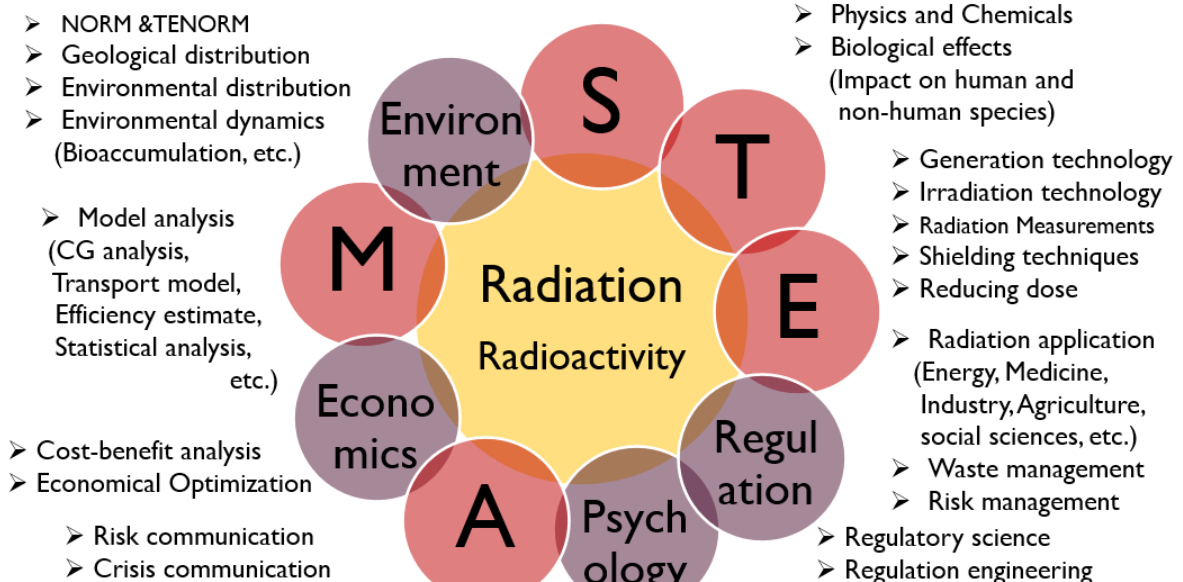
radiation protection, radiation safety, regulatory science, radiation measurements, dosimetry, radiation control, environmental radiation and radioactivity, radiation education, risk education, risk communication

He is a professor and the Radiation Safety Promotion Manager (RSPM) of The University of Tokyo, leading total activities on the safety culture improvement. He is a Managing Director of Japan Health Physics Society, and Editor in Chief of Journal of Radiation Protection Research, co-operated by RP societies in Korea, Australasia and Japan. In addition, he is one of the expert members in several national committees or meetings of Japanese government for radiation protection and safety as well as for human resource development in the field of nuclear science and technology. He has been one of the international experts involved in RAS 0065/0079 TCP (2012-2021) of IAEA and shared his wide knowledge and his HRD experiences in the radiation protection field with participant countries. He is the Course Director of IAEA TTWS 2021 JPN.

Science Technology Engineering Art and Mathematics for HRD

Keywords used for Radiation Relating to “STEAM”

Focusing on Radiation Protection



Viewpoint from social science is also important.

Lecture 2

Basic

Latest consensus in radiobiology



Noriko HOSOYA

Associate
Professor /
MD, PhD

Laboratory of Molecular Radiology, Center for Disease Biology and Integrative Medicine, Graduate School of Medicine, The University of Tokyo

<https://www.cdbim.m.u-tokyo.ac.jp/en/research/laboratory07/>

Scope Keywords

radiation biology, basic radiation medicine, DNA damage response, DNA repair, homologous recombination, genomic instability, cancer biology, cancer therapy, radiotherapy, chemotherapy, health effects of radiation, radiation protection, radiation education

She is an associate professor at the Laboratory of Molecular Radiology at the University of Tokyo. Her research focuses on the molecular mechanisms of DNA double-strand break repair and genomic instability as a scientific basis for developing novel therapeutic strategies for cancer. She is also responsible for the education of basic radiation medicine for medical students and graduate students in the University of Tokyo, including 2-day practical training course where she teaches how to handle radioactive materials safely. In addition to her work at the University of Tokyo, she serves as a Director of the Japanese Radiation Research Society (JRRS) and a Councillor of the Japanese Cancer Association (JCA).

-STEAM related to Lecture-

Education Items	Science(S), Math(M)	Technology(T), Engineering(E)	Arts(A), Others
Introduction	DNA, sugar, phosphate, bases, strands, double-helix, genes, chromosomes, RNA, proteins, genetic information, cell, nucleus, DNA replication, cell cycle	—	Watson and Crick, Nobel prize, human diseases, human health
DNA damage	Ionizing radiation, X-ray, water molecules, water-derived radicals, physical energy deposition, chemical change, ultraviolet ray, genotoxic chemicals, metabolic process, cosmic rays, radon	—	Roentgen, diagnostic and therapeutic medical exposures, chemotherapy
DNA damage response	Signal transduction, DNA repair, cell cycle arrest, cell death, gene mutations, organ failure, cell fate	—	Nobel prize in chemistry 2015, Tomas Lindahl, Paul Modrich and Aziz Sancar
Abnormality of the DNA damage response and cancer development	Multistep carcinogenesis, genomic instability, tumor suppressor gene	—	Hereditary disease, hereditary cancers, non-hereditary cancers
Targeting DNA damage response in cancer therapy	New therapeutic approach	Drug discovery	Cancer therapy

Lecture 3

Basic

Latest consensus in radiation epidemiology



Michiya SASAKI

PhD

Biology and Environmental Chemistry Division, Sustainable System Research Laboratory, Central Research Institute of Electric Power Industry

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Scope Keywords

radiological protection, radiation measurement, neutron detector, Monte-Carlo calculation, low-level gamma-ray detection, radioactive waste, transport of radioactive material, epidemiology, risk estimation, risk transfer, internal dosimetry

He is a senior research scientist in the Biology and Environmental Chemistry Division, Sustainable System Research Laboratory, Central Research Institute of Electric Power Industry (CRIEPI) of Japan, and is currently working on research related to radiation risk assessment and optimization in radiological protection. He is a member of the board of directors of the Japan Health Physics Society (JHPS) and Chair of the International Correspondence Committee. He previously worked at the Scientific Secretariat of the International Commission on Radiological Protection (ICRP) in Ottawa from 2012 to 2014.

-STEAM related to Lecture-

Education Items	Science(S), Math(M)	Technology(T), Engineering(E)	Arts(A), Others
Epidemiology	Public health, Observation	Radiation measurement	Hiroshima, Nagasaki, Atomic bomb
Radiation effects	Biology, Tissue reaction, Stochastic effects	Classification, Mechanism, Analysis	DNA, Stem cells, Nobel Prize
Radiation exposure	Radiation, Radioactive materials	Radiation detectors, Medical applications, Nuclear fission, Nuclear reactors, Environmental radioactivity	History, Energy, Environment
Health risk	Cancer, Circulatory diseases	Statistics, Medical diagnosis technology	WHO
Dosimetry	Simulation, Monte Carlo calculation, Radioactivity in the body	Activation analysis, Radiation measurement	Computational science
Risk estimation	Ratio, Additive and Multiplicative models, Statistics	Uncertainty, Statistical calculation	Tobacco and lung cancer, Lifestyle, Use of risk information
Risk transfer	Additive and Multiplicative models, Statistics	Uncertainty, Probability of causation	UNSCEAR, ICRP, IAEA

Lecture 4 Basic

Nuclear physics, radiation physics and chemistry



Hiroyuki A. TORII

Associate
Professor/
PhD

School of Science, The University of Tokyo

<http://radphys4.c.u-tokyo.ac.jp/~torii/lecture/>

Scope Keywords

Radiation physics, radiochemistry, high-energy physics, muon physics, spectroscopy of exotic atoms and molecules, atomic collision, radiation education, risk communication, science communication, analysis of twitter data.

He is an associate professor, in charge of radioisotope laboratory and is the chief of Radiation Management Office in School of Science. His main research activities are spectroscopic and collisional studies of exotic atoms. He spent 20 years for his study of antiprotonic atoms at CERN in Geneva, before moving to the study of muonic atoms at J-PARC in Tokai village. After the Fukushima NPP accident in 2011, he started up an educational program on radiation at College of Arts and Sciences in UTokyo, as well as an interdisciplinary study of risk and science communication by analyzing big data on social media.

-STEAM related to Lecture-

Education Items	Science(S), Math(M)	Technology(T), Engineering(E)	Arts(A), Others
nuclear physics	periodic table, nuclear structure, stability of nuclei, nuclear fission, nuclear fusion	atomic power generation, nuclear energy, atomic bomb	atom, nucleus, microscopic world, alchemy and chemistry, radioactive materials
radioactive decay	alpha ray, beta ray, gamma ray, X-ray, isotope	--	uranium, radon, chronology of the earth
radiation physics	radiation, particle, photon, mass	--	P. & M. Curie, Einstein, electromagnetic wave
ionization by charged particles	Coulomb force, ionization, atomic excitation, scintillation (fluorescence induced by radiation)	measurement of radiation, cancer therapy by heavy ion beam	DNA damage, shielding of radiation, radiation protective suit
attenuation of photons	photoelectric effect, Compton scattering, electron pair production, particle nature of light, positron	Röntgen radiography, CT scan, radiopaque substances, PET (positron emission tomography), dose calculation	radiological diagnosis, shielding of radiation
neutron reaction	nuclear reaction, activation	nuclear reactor, reactor building, accelerator facility	collision of golf balls, billiard
radiation chemistry	ionization and dissociation of molecules, free radical, active oxygen	cellulose gel, polymer	radial tires, foamed materials
spectroscopy experiment of exotic atoms	exotic atom, muon, antiproton, accelerator experiment, spectroscopy, elementary particle, standard model, antiparticle	accelerator science, laser technology, microwave technology, precise measurement	cosmic ray, particle accelerator, antimatter world, science fiction

Lecture 5

Basic

Radiation measurement and accelerator science



Professor /
PhD

Hiroyuki MATSUZAKI

Micro Analysis Laboratory, Tandem accelerator (MALT)
The University Museum/Department of Nuclear Engineering and Management,
School of Engineering, The University of Tokyo
<http://malt.um.u-tokyo.ac.jp/~hmatsu/>

Scope Keywords

Accelerator Mass Spectrometry
Electrostatic Accelerator
Radiation Detection
Isotope Geochemistry
Beam Analysis
Ion Beam Engineering

He is a head of Micro Analysis Laboratory, Tandem accelerator (MALT), The University of Tokyo. He also a professor of The University Museum, The University of Tokyo and Department of Nuclear Engineering, School of Engineering, The University of Tokyo. He manages MALT facility which has 5MV tandem accelerator and excellent beam lines for AMS (Accelerator Mass Spectrometry) and Beam analysis system. He is studying the technical development of AMS and also the earth-environmental sciences using special isotope system such as $^{14}\text{C}/^{13}\text{C}/^{12}\text{C}$, $^{129}\text{I}/^{127}\text{I}$. He is a member of international scientific advisory committee of Accelerator Mass Spectrometry and a head of Japanese AMS society.

-STEAM related to Lecture-

Education Items	Science(S), Math(M)	Technology(T), Engineering(E)	Arts(A), Others
Cosmic rays	Nuclear reaction, proton, neutron, muon	Baloon, Flying observer	Victor Franz Hess
Source of radiation	Radio isotopes, Accelerators, Nuclear Reactors	Accelerators, Nuclear reactors	Van de Graaff, Ernest Lawrence
Nuclear decay	Exponential function, structure of nucleus	Radiation detectors	Ernest Rutherford,
Tandem accelerator	Electrostatic accelerator	Electrostatic engineering	Van de Graaff
AMS	Mass spectrometry, charged particle, isobar, precision, accuracy	Ion source, Vacuum engineering, Data acquisition	Rochester, nec, HVE
Radiocarbon dating	Half life, fractionation, calibration	beta counter, AMS, pre-treatment	Willard Frank Libby
Isotope geochemistry	Paleo environment, climate change, anthropocene	Isotope analysis	Carbon neutral, SDGs

Lecture 6 Basic

Risk communication in radiation protection



Reiko KANDA

Deputy Director General/ PhD

Deputy Director General of National Institutes of Radiological Sciences (NIRS), National Institutes for Quantum and Radiological Science and Technology (QST)

Scope Keywords

radiation protection, radiation safety, regulatory science, biological dosimetry, radiation effects, risk analysis, radiation emergency, radiation education, risk communication

She is Deputy Director General and Director of Department of Radiation Regulatory Science Research, NIRS-QST, Japan. Her research interest and areas of expertise are radiation-induced chromosome aberrations, health effects of radiation and dose estimation. She cooperated with the government in preparing explanatory materials for the public such as the sub textbooks on radiation for all elementary, junior high and high school students. She is a member of the Radiation Council of Japan (2014-present) and since 2020, the secretary of Section II (life sciences) of the Science Council of Japan. She has been a member of Japanese delegation to UNSCEAR since the 64 th session (2017) and is the Alternate representative since 2019.

-STEAM related to Lecture-

Education Items	Science(S), Math(M)	Technology(T), Engineering(E)	Arts(A), Others
radiation exposure	α -particle, β -particle, γ -ray, X-ray	artificial radiation, electric waves, ultraviolet ray	atomic bomb, radiation anxiety
disaster	natural disaster, man-made catastrophe	aircraft, train, chemical plant, nuclear facility	victims, disaster psychology, terrorism, war
health risk	statistics, disease, injury, mortality, incidence	GMO crops, pesticide, food additives, vaccine, asbestos, accident	safety philosophy and concept
cancer	gene mutation, tumor, leukemia, tumor initiator, tumor promoter, sensitivity of children	carcinogenesis, environmental contamination	Hermann Joseph Muller
health condition	genetic background, life style, eating habit, obesity	healthcare level	well-being
safety	dose assessment, risk assessment, dose-response relationship	risk-benefit analysis, cost-benefit analysis, dose limit, emission concentration control, total mass emission control	risk perception, social psychology, cognitive bias, cognitive gap
risk assessment	animal experiment, epidemiology, attributable proportion	risk management, precautionary principle, regulatory science	right to know, right not to know

Lecture 7 Academic

Radiation protection in food



Keitaro TANOI

Professor / PhD

Isotope Facility for Agricultural Education and Research,
Graduate School of Agricultural and Life Sciences,
The University of Tokyo
<https://webpark1571.sakura.ne.jp/radioplantphys/>

Scope Keywords

agriculture, agricultural products, foods, radiocaesium, monitoring, inspection, standard, radionuclide, radioecology

He is a professor at The University of Tokyo and opens his research laboratory of Radio Plant Physiology in Graduate School of Agricultural and Life Sciences, the University of Tokyo to investigate plant science using radioisotopes with undergraduate students and Master/Doctor course students. He has been involved in radioecology in Fukushima since 2011. He is the Vice Director of the Radiation Management Department in the Division for Environment Health and Safety, The University of Tokyo.

-STEAM related to Lecture-

Education Items	Science(S), Math(M)	Technology(T), Engineering(E)	Arts(A), Others
Crop	food, plant, soil, weather,	fertilizer, irrigation, genome editing	Food culture
Soil	Soil chemistry, Soil physics, Clay minerals	Plow, fertilizer, soil analysis	Food, Crop
Plant nutrition	Minerals, element, carbon dioxide (CO ₂), chemistry, biology	fertilizer, gene, membrane protein, response, environmental stress, problem soil	Environmental protection
internal exposure from food	radiation protection, decontamination, dose	inspection, calculation, distribution	staple food
radioecology	radiation, radioisotopes, ecology, environment, field, detection	field work, detector,	Food
Agriculture	environment, weather, crop science	breeding, genome editing	Environmental protection, Environmental load

Lecture 8 Academic

RP system and protection for natural radiation and radioactivity



Takeshi IIMOTO Professor / PhD

Graduate School of Frontier Sciences, The University of Tokyo

<http://envsys.k.u-tokyo.ac.jp/field.html?key=1446429955>

Scope Keywords

radiation protection, radiation safety, regulatory science, radiation measurements, dosimetry, radiation control, environmental radiation and radioactivity, radiation education, risk education, risk communication

He is a professor, hosting Laboratory of Environmental Safety Management, Department of Environment Systems, Graduate School of Frontier Sciences, The University of Tokyo. The research field "Environmental Safety Management" covers all studies on safety and risk management, mainly in radiation environments. He pursues the studies from the viewpoints of both natural and social sciences. The main research targets are: Development of methods for radiation measurement and dosimetry/ Study of safety measures for radiation applications and the management of radioactive waste materials /Study on natural radiation environments and naturally occurring radioactive materials /Study on environmental protection and environmental assessment on radiation /Study on risk management and risk communication, etc. The research themes are selected from timely discussion points and needs relating to activities of IAEA, UNSCEAR, ICRP and regulatory science in Japan.

-STEAM related to Lecture-

Education Items	Science(S), Math(M)	Technology(T), Engineering(E)	Arts(A), Others
exposure from the Earth (ground)	Origin of the Earth, Geology, Granite	Building materials	Drs. Curie, Dr Becquerel
exposure from food	Plant growth, Potassium, Polonium	Artificial fertilizer	Food culture, Seafood
exposure by breathing (radon)	Three embodiments of the substance, Uranium series, Thorium series, Respiratory organs, Aerosols	Basement use, Ventilation, Gas measurement, Particle measurement	Living environment culture, Cloud chamber, WHO Lung cancer, Hot springs, Cancer treatment
exposure by cosmic rays	Origin of the universe, Stars, Earth's magnetic field	Aircraft, Moon surface development, Manned space flight	Nobel prize, Spark chamber, Nuclear fusion
exposure dose	Arithmetic mean, Sample mean	Radiation measurement	United Nations Scientific Committee
NORM	Tritium, Samarium, Potassium, Polonium	Mineral industry, Pottery industry, Fertilizer factory, Thermal power generation	Underground resources, Resources in the sea
Radiation protection system	—	—	Safety philosophy, Safety standards, History and culture, Risk, Communication, Stakeholder



Takumi SAITO

Associate
professor / PhD

Nuclear Professional School, School of Engineering
The University of Tokyo

<http://park.itc.u-tokyo.ac.jp/saitolab>

Scope Keywords

Geochemistry
Radioactive wastes
Geological disposal
Transport modeling
Environmental behavior
Advanced spectroscopy

He is an associate professor at Nuclear Professional School, School of Engineering, the University of Tokyo. He had original education in nuclear engineering, but his expertise is chemistry, in particular geochemistry and physical chemistry. He works in the field of nuclear waste disposal with special focuses on environmental behaviors and transport of radionuclides in various environments including subsurface environments. He does both experiments and simulations and both laboratory works and field studies.

-STEAM related to Lecture-

Education Items	Science(S), Math(M)	Technology(T), Engineering(E)	Arts(A), Others
Radioactive wastes	-	Industrial wastes, Pollution, Environment	Trash
Disposal	-	Landfill, Barrier	Dump, Polluter's pay principle
Radiation protection in the operational period	Radiation-material interaction, Decay	Radiation management, Radiation dose, ALARA	-
Radiation protection in the post-closure period	Decay, Transport, Geology, Hydrology, Geochemistry	Environmental risk assessment	Far future, estimation
Risk communication	Psychology	Trans-science, Bias	Trust

Lecture 10

Academic

Analytical understanding of radiation behavior



Tatsuhiko OGAWA

PhD

Research Group for Radiation Transport Analysis, Division of Environment and Radiation Sciences, Nuclear Science and Engineering Center, Japan Atomic Energy Agency
<https://nsec.jaea.go.jp/ers/radiation/en/rpro/index.htm>

Scope Keywords

- Radiation transport
- Monte-Carlo method
- Sn method
- Computation
- Nuclear/Atomic reactions
- Facility design
- Exposure simulation

He is a researcher at Japan Atomic Energy Agency.

At the Graduate School of Engineering, University of Tokyo, working as an intern at Stanford Linear Accelerator Center (currently SNAL) and at European Organization for Nuclear Research (CERN), he was certified as Ph.D. Entering Japan Atomic Energy Agency as a Post-doctoral fellow, he became tenured researcher in 3 years.

Except 1 year of sabbatical at Commissariat à l'énergie atomique et aux énergies alternatives (CEA) in France, he works as a member of the research group for radiation transport analysis at JAEA.

-STEAM related to Lecture-

Education Items	Science(S), Math(M)	Technology(T), Engineering(E)	Arts(A), Others
Radiation	Particles, Probability	Reactor, Accelerator, Shield	Schrodinger's cat
Simulation	Matrix calculation, Sequential calculation	Processor, Memory	3D amination, Dice, Pin ball,
Monte-Carlo method	Random number, Monte Carlo integration	Random algorithm	Casino, Stanisław Marcin Ulam, John von Neumann
Finite element method	Iterative calculation, Matrix,	Mesh generation algorithm	Mozaic pattern, Los Alamos National Laboratory
Computation	Binary system, Exponent	Computer	IT companies
Exposure	Space radiation, Solar activity	International space station, soft error	International standard, Scientific policy making
Facility design	Nuclear fusion, Neutron microscopy	Radiation therapy, Radiation facility	Safety assessment

Lecture 11

Advanced

Advanced understanding of radiation units



Hiroshi YASUDA

Professor / PhD

Department of Radiation Biophysics, Research Institute for Radiation Biology and Medicine, Hiroshima University

<https://seeds.office.hiroshima-u.ac.jp/profile/ja.8b44ff1859dd3d61520e17560c007669.html>

Scope Keywords

radiation measurements, radiological protection dosimetry, , cosmic radiation dosimetry, radiological emergency responses, retrospective dose assessment, environmental impact analysis, , health risk projection, radiation education related to atoms for peace.

He is a professor and scientist in the field of radiation measurements, radiological protection, retrospective dose assessment, cosmic radiation dosimetry, health risk analyses, environmental impact analyses and so on. He has published nearly 200 scientific articles and more than 50 reviews/books. He has been working as experts for various international bodies such as United Nations, IAEA, ISO, ICRP, EURADOS and many national bodies such as Nuclear Regulation Authority, Ministry of the Environment, Ministry of Education, Culture, Sports, Science and Technology.

- STEAM related to Lecture -

Education Items	Science(S), Math(M)	Technology(T), Engineering(E)	Arts(A), Others
variety of dose	ionization, energy deposition	terminology, regulation	Gray, Sievert
deterministic effects (tissue reactions)	pathology, physiology	medical diagnosis, treatment	medicine, pharmaceutical
biological dose	radiation biology, clinical presentation	heavy ions, neutrons	particle accelerator
relative biological effectiveness	survival ratio, dose rate effect	radiation weighting, linear energy transfer (LET)	high-LET radiation field
stochastic effects	epidemiology, genomic analysis	health risk assessment	QOL
effective dose	radiological protection dosimetry	prospective dose assessment	compliance with dose limits
Reference Person	anatomical analysis	mathematical phantom	age- & sex-averaging
Application of effective dose	collective analysis	risk projection	regulation

Lecture 12

Advanced

External exposure dosimetry and its practice



Group leader/
PhD

Fumiaki TAKAHASHI

Radiation transport analysis group, Division of environment and radiation science, Nuclear science and engineering center, Japan Atomic Energy Agency (JAEA)

Scope Keywords

radiation protection, radiation transport analyses, radiation dosimetry, radiation measurements, external exposure, internal exposure, accidental dosimetry

He is a group leader of Radiation transport analysis group, Division of environment and radiation science, Nuclear science and engineering center in the Japan Atomic Energy Agency (JAEA). He has been engaged in researches and developments in below.

- External dosimetry, calibration of radiation measurement instruments and dose assessments for an accidental exposure
- Radiation monitoring after the Fukushima Dai-ich Nuclear Power Plant accident in 2011
- Internal dosimetry based upon the newest dosimetry data and models

In addition, he is a member of the General Secretary of Japan Health Physics Society (from 2015 to 2021).

-STEAM related to Lecture-

Education Items	Science(S), Math(M)	Technology(T), Engineering(E)	Arts(A), Others
external exposure	Radioactive material, Accelerator	Building materials	Worker, Public
use of radiation	Atomic power, Radiation	Nuclear power plant, Medicine, Industry	Welfare for society
radiation doses	Energy, Mass, Human body, Health effect		Sievert, Gray
radiation protection for external exposure	Time, Distance, Photon, Neutron	Shielding (Concrete, Iron, Lead and so on), Facility with radiation (or nuclear)	Worker, Public(Society)
dosimetry for protection (dose conversion)	Units (Energy, Mass, Surface Area), Graphs, Numerical data	Computer Science, Diagnostic images	International Commission on Radiological Protection
dosimetry for protection (shielding)	Equations, Functions	Shielding (Concrete, Iron, Lead and so on)	Building
radiation measurement (monitoring)	Photon, Neutron	Dosimeter, Radiation measurement instruments (rem-counter, survey meter and so on)	Worker, Public(Society)
medical exposure	Medicine (Diagnostic, Therapy)	CT examination, BNCT (Therapy for cancer)	Health, Disease

Lecture 13

Advanced

Internal exposure dosimetry and its practice



Kotaro TANI

PhD

Department of Radiation Measurement and Dose Assessment, National Institute for Radiological Sciences (NIRS), National Institutes for Quantum and Radiological Science and Technology (QST)
<https://www.qst.go.jp/site/carem/>

Scope Keywords

radiation protection
 individual monitoring
 internal dose assessment
 biokinetic model analysis
 radiation transport simulation

He is a senior researcher of the National Institute of Radiological Sciences (NIRS), the National Institutes for Quantum and Radiological Science and Technology (QST). He has experience for more than ten years in research related to radiation protection, in particular internal dose assessment, and is a member of the task group on emergency dosimetry in International Commission on Radiological Protection.

In 2014, he started his work at the NIRS after receiving his PhD in engineering from the University of Tokyo, Japan. He was seconded to the secretariat of the United Nations Scientific Committee on the Effect of Atomic Radiation (UNSCEAR) for 2 years in 2015-2017 and assisted with the UNSCEAR's Fukushima follow-up project as a project officer.

-STEAM related to Lecture-

Education Items	Science(S), Math(M)	Technology(T), Engineering(E)	Arts(A), Others
Radiation exposure	Natural radiation, Artificial radionuclide, Health effect	Nuclear power plant, Radiation diagnosis/treatment	Radiation protection, Dose assessment, Nuclear/radiation accident, Radiation anxiety
Internal exposure dosimetry	Biokinetics, Energy absorption, Radiation sensitivity	Individual monitoring (direct counting, bioassay), Biokinetic model analysis, Radiation transport simulation	Retention/excretion function, Committed effective/equivalent dose, Risk perception
Biokinetic model analysis	Metabolism, Case study, Animal experiment	Compartment model, Numerical analysis	Intake scenario (nuclide, pathway, chemical form, particle size, breathing rate)
Radiation transport simulation	Nuclear data, Radiation-material interaction, Anatomical data	Monte-Carlo method, Numerical human phantom, Computer simulation	Radiation/tissue weighting factor
Nuclear/radiation emergency	Health risk, Radiation syndrome	Decontamination, Medical treatment, Decorporation agent, Medical/risk communication	Nuclear/criticality/radiation accident, Nuclear terrorism, Loss/theft of radiation source

Lecture 14

Application

Management and radiation protection practice of radiation facilities



Shogo HIGAKI

PhD

Isotope Science Center, the University of Tokyo

<https://higaki.ric.u-tokyo.ac.jp/>

Scope Keywords

- Nuclear and Radiochemical Sciences
- Radiation Safety Management
- Environmental Radioactivity
- Environmental Chemistry

Shogo Higaki was educated at School of Science, the University of Tokyo. He got specialized teaching certificates of high school and junior high school in 2001. He joined Isotope Science Center (ISC) after earned PhD degree in 2006 on a topic in atmospheric chemistry by using tritium. He got the certificate of first-class radiation protection supervisor in 2007. Since then, he has been supervising radiation safety management at the ISC as a radiation protection expert. He has been serving a lecturer of qualification training for first-class radiation protection supervisor since 2011. He has been serving as a director of the Japanese society of Radiation Safety Management (JRSM) since 2018 and the chair of organizing committee for the JRSM annual virtual meeting in 2020. He will be vice chair of the 7th Asia-Pacific symposium on radiochemistry at Koriyama/Fukushima in 2022.

-STEAM related to Lecture-

Education Items	Science(S), Math(M)	Technology(T), Engineering(E)	Arts(A), Others
Historical background of regulations in Japan	X-ray, radiograph	Cyclotron, generation of radioisotopes	World War-II
Outline of regulations concerning radiation in Japan	Radiation, Radioisotopes	Reactor, Accelerator	Hierarchy of Japanese Act
Requirements and practice of ISC – UTokyo		Radiation measurements	Permission of using radiation, Education and training, Health surveillances
Practice for Safety handing of Unsealed Radioisotope	Radioisotopes, Alpha particle, DNA breaks	Draft (fume hood)	

Lecture 15 Application

Management and radiation protection practices in nuclear facilities



Makoto HASHIMOTO

PhD,
P.E.

Radiation Protection Department, Sector of Research and Advanced Reactor Research and Development, Oarai Research and Development Institute, Japan Atomic Energy Agency

<https://www.jaea.go.jp/english/index.html>

Scope Keywords

Radiation Protection, Radiation Control, Radiation Measurement, Environmental Radiation Monitoring, Personal Dose Monitoring, Dose Evaluation, Quality Management, Safety Control, Nuclear Facility, Nuclear Transport

He is a deputy director of Radiation Control Division, Oarai Research and Development Institute, Japan Atomic Energy Institute and the Radiation Protection Supervisor of ORDI. He is in charge of radiation control of nuclear facilities, environmental monitoring and personal dose monitoring for 30 years. He is doctor of engineering, especially for radiation protection and radiation measurement. He is also a visiting researcher of UTokyo. He is a director of Japan Health Physics Society in charge of planning. He is also a member of some investigative committees for measures of radiation control and radiation protection in Japan.

-STEAM related to Lecture-

Education Items	Science(S), Math(M)	Technology(T), Engineering(E)	Arts(A), Others
design of facility	nuclear reaction, shielding, containment	building materials, shieldig materials, design, construction	defence in depth, potential exposure, dose limit, dose constraint, legal system, permission, inspection
area control	radiation measurement, shielding	radiation measurement, radiation monitor, surveymeter,	permission, safety regulations, manuals, controlled area, dose constraint
work control	-	personal dosimeter, surveymeter, protective equipment, respirator	ALARA, safety regulations, manuals, dose constraints, RP optimisation, work nalysis, PDCA
personal dosimetry	personal dose,	personal dose evaluation, personal dosimeter, whole body counter, bioassay	dose limit, dose constraint, exposure control, ALARA
emission control	diffusion of radioactive material	radiation monitor, Gamma-ray radionuclide analysis,	ALARA, dose constraints,
environmental radiation monitoring	environmenta dynamics of radioactive material	monitoring post, Gamma-ray radionuclide analysis, chemical analysis	dose constraint, living environment, eating habit
accident management	containment, shielsing, environmenta dynamics of radioactive material	monitoring post, monitoring veicle, surveymeter	permission, safety agreement, evacuation plan, safety regulations, manuals, dose constraint
International trends in RP of natural sources	nondestructive testing,	decontamination, decomissioning	permission, potential exposure, clearance

Lecture 16

Application

Radiation protection for the public in nuclear emergency



Kazumasa SHIMADA

PhD

Japan Atomic Energy Agency, Nuclear Safety Research Center
Reactor Safety Research Division, Risk Analysis Research Group

https://www.jaea.go.jp/04/anzen/en/group/rarg/index_e.html

Scope Keywords

radiation protection, radiation measurements, dosimetry, radiation health risk analysis, probabilistic risk assessment, nuclear emergency preparedness and response, evacuation, risk communication

He is a researcher at JAEA. He graduated Tokyo Science University, Physics department. His first research topic is the measurement of radon from soil@ National Institute of Radiological Sciences. He graduated from The University of Tokyo, graduate school, Nuclear Engineering and Management, Kosako-Iimoto Lab. Master thesis title is "Development of the personal dosimeter for high energy neutron using CR-39. Doctor thesis title is "Uncertainty of external dose evaluation using personal dosimeter"

After he graduated from The University of Tokyo, he started research at JAEA Dose evaluation for Fukushima residents, Radiation health risk model, Level 3 Probabilistic Risk Assessment, Nuclear Emergency Response, Airborne Monitoring. He is an alumni of World Nuclear University at Sweden, 2015. He is a visiting researcher at the University of Illinois Urbana-Champaign (April 2019-March 2020)

-STEAM related to Lecture-

Education Items	Science(S), Math(M)	Technology(T), Engineering(E)	Arts(A), Others
Great East Japan Earthquake	Geology, Tunami	Disaster prevention	Natural disasters
Nuclear Power Plant	Heat, Electricity	Power generation	Safety culture
Radionuclides	Radiation, light	Radiation measurements	Drs Curie, Dr Bequerel
Evacuation	Speed	Automobile	Human behavior
Sheltering in place	Shielding, Attenuation	Building materials, Architecture	Living space comfort
Helicopter	Buoyancy	Aircraft	Self-Defense Force
Meteorological data	Meteorology, rain, wind	Meteorological observation	Big data
Uncertainty	Probability, statistics	Random number	Sampling

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