A RadoNorm short course entitled:

CELET: Cellular effects of high and low LET ionising radiation – introduction to radiation biology

Stockholm University, Sweden
11.11.2024 – 22.11 2024

Version 2024 11 21

Course description and program

The aim of the course is to acquaint students with techniques of studying genotoxic effects of ionising radiation which are of relevance for RadoNorm and the broad field of radiation research. The target group are students and young researchers with various backgrounds who want to get a basic introduction to biological effects of radiation. The course will contain both lectures and practical laboratory work. The lectures will focus on various aspects of biological effects of low and high LET ionising radiation as well as on techniques to detect them using cytogenetics and immunogenetics.

To facilitate work in the lab the students will be divided into 4 groups. Each group will carry out one experiment with different endpoints. At the end of the course students will present and discuss their results.

The course lectures will be held in the morning hours during week one. Practical work will be carried out in the afternoon hours of week 1 and during the whole days of week 2. The practical work will be divided into a "lab-teaching" part and a "results-analysis" part. Each group will learn 4 techniques (see below). Hence, each student will spend 4 time-blocks in the lab, where she/he will carry out the steps associated with a technique. The rest of the practical time will be devoted to learning how to analyse cells on microscopic slides/images. The rationale for dividing the students into small groups is that it will allow them to really perform the work and not only watch a demonstration. Each group will be supervised by an experienced employee of the SU.
Each group will also learn how to irradiate cells using the exposure facilities at SU: low-dose rate ^{137}Cs exposure facility, high dose-rate ^{137}Cs exposure facility, X-ray facility and ^{241}Am alpha-exposure facility. Although students will learn how to generate microscopic slides/images that can be used for analysing the results, the scoring part of the curse will be carried out using slides/images prepared beforehand by the SU employees. This strategy will guarantee high quality slides/images for scoring. At the end of the course the achieved results will be collated, statistically analysed and discussed.
Students will learn 4 techniques:

1. Basic dosimetric measurements and techniques of exposing cells to gamma rays and alpha particles. Students will use low activity gamma radiation sources to measure 1) dose rates in air as a function of distance from the source, 2) the energy spectrum of gamma radiation from ^{137}Cs and ^{133}Ba, 3) the effect of shielding. Dosimetric measurements of high activity ^{137}Cs sources will also be carried out. The nuclide content of a radioactive mineral will be determined by analysing its energy spectrum. Radon activities will be measured with an AlphaGuard meter in air drawn from an encapsulated ^{226}Ra source and in a basement room. Build up of ^{222}Rn disintegration products will be demonstrated by measuring the increment of gamma radiation in a chamber filled with ^{222}Rn. Techniques of exposing cells to gamma radiation (^{137}Cs) and alpha radiation (^{241}Am) will be demonstrated.
2. Preparation of slides for analysis of chromosomal aberrations and micronuclei as well as microscopic analysis of chromosomal aberrations on Giemsa-stained slides. A microscope will be available for each student. Slides will contain cells exposed to A) gamma radiation and alpha particles (demonstration of the concept of relative biological effectiveness), B) cells exposed to high and low dose rate (aim: demonstration of the dose rate effect), C) cells exposed at different phases of the cell cycle (aim: demonstration of cell cycle phase-related radiosensitivity). Each student will receive a part of the slides for analysis. At the end of the course results will be summarised, compared and discussed.
3. In situ hybridisation with whole chromosome probes (FISH) as well as image-based analysis of aberrations in painted chromosomes. Analysis will be done manually on digital images (aim: demonstration of stable and unstable-type aberrations).
4. Detecting gamma H2AX foci and image-based analysis of foci. Analysis will be done on digital images using the Image J software (aim: demonstration of analysis technique taking into account focus size as well as focus distribution).

Experiments will be carried out with RPE-1 cells (aberrations and gamma H2AX). The cell lines/techniques are established and currently used in our laboratory.

		CELET course. **Lectures start at 09:00**	
Date	**Room**	**Event** ZOOM link: https://stockholmuniversity.zoom.us/j/69140094519	**Lecturer**
Mo 11/11	P216	09:00 – 10:30 Chromosomal aberrations	Christian Johannes
	P216	10:45 – 12:15 DNA damage and repair (ZOOM)	Penny Jeggo
	E518	14:00 – 17:00 Harvesting cells for aberrations – group 3	Zuza
	E518	14:00 – 17:00 GammaH2AX exercise – group 4	Nadia
	E214	14:00 – 17:00 Scoring – group 1 and group 2	Maddi, Samuel and Prabodha
Tue 12/11	E314	09:00 – 10:30 Factors which influence cellular radiosensitivity	Lovisa Lundholm
	E314	10:45 – 12:15 Combined exposures of radiation and other stressors (ZOOM)	Helga Stopper
	E210	14:00 – 17:00 Dosimetry exercise – group 4	Andrzej
	E518	14:00 – 17:00 FISH exercise – group 1	Prabodha
	E214	14:00 – 17:00 Scoring – group 2 and group 3	Maddi and Samuel
We 13/11	P216	09:00 – 10:30 AI and its use in radiation research	Beata Brzozowska
	P216	10:45 – 12:15 Bystander effects of radiation	Munira Kadhim
	E210	14:00 – 17:00 Dosimetry exercise – group 3	Andrzej
	E518	14:00 – 17:00 FISH exercise – group 2	Prabodha
	E214	14:00 – 17:00 Scoring – group 1 and group 4	Maddi and Samuel
Thu 14/11	D502	09:00 – 10:30 Radiation effects on the immune system and the use of radon to treat autoimmune diseases	Serge Candeias
	D347	10:45 – 12:15 Radiation-induced micronuclei (ZOOM)	Anne Vral
	E210	14:00 – 17:00 Dosimetry exercise – group 2	Andrzej
	E518	14:00 – 17:00 FISH exercise – group 3	Prabodha
	E214	14:00 – 17:00 Scoring – group 1 and group 4	Maddi and Samuel
Fri 15/11	Q211	09:00 – 10:30 Statistical analyses of experimental results from low and high throughput approaches in radiation research	Joanna Polanska
	Q211	10:45 – 12:15 Radiation-induced gammaH2AX foci	Harry Scherthan
	E210	14:00 – 17:00 Dosimetry exercise – group 1	Andrzej
	E518	14:00 – 17:00 FISH exercise – group 4	Prabodha
	E214	14:00 – 17:00 Scoring – group 2 and group 3	Maddi and Samuel
Sat 16/11		Trip to Uppsala	All
	E512	18:00 Dinner at SU – social room on level E5	All
		Sunday – free. On Monday exercises start at 09:30	
Mo 18/11	E518	09:30 – 13:00 Harvesting cells for aberrations – group 1	Zuza
	E518	09:30 – 13:00 GammaH2AX exercise – group 3	Nadia
	E214	09:30 – 13:00 Scoring – group 2 and group 4	Andrzej
	E214	14:00 – 17:00 gH2AX analysis and scoring – all groups	Nadia
Tue 19/11	E518	09:30 – 13:00 Harvesting cells for aberrations – group 2	Zuza
	E518	09:30 – 13:00 GammaH2AX exercise – group 1	Nadia
	E214	09:30 – 13:00 Scoring – group 3 and group 4	Andrzej
	E214	14:00 – 17:00 Scoring – all groups	Andrzej

We 20/11	E518 E518 E214 E214 E512	09:30 – 13:00 Harvesting cells for aberrations – group 4 09:30 – 13:00 GammaH2AX exercise – group 2 09:30 – 13:00 Scoring – group 1 and group 3 14:00 – 17:00 Scoring – all groups 17:00 – Swedish food tasting	Zuza Nadia Andrzej Andrzej
Thu 21/11	E214 E214	09:30 – 12:00 Scoring and preparing presentations – all groups 14:00 – 17:00 Scoring and preparing presentations – all groups	Andrzej Andrzej
Fri 22/11	E314	09:30 – 12:00 Presentation of results, discussion, all groups End of course	All
		Weekend	

Division into groups and topic of presentation on Friday 22 November

Group 1 - dosimetry

Barłomiej	Kociński
Lama	Ramadan
Teresa	Irianto
Hasanul	Banna
Maja	Beckmann
Kiran	Dhakal
Eiman	El Mahdi
Tountzai	Elmali

Group 2 – dicentrics and FISH

Agata	Taranienko
Mai	Fukushi
Asif Hussain	Shah
Gongming	Zhang
Elvira	Karlsson
Sara	Malkic
Osasenaga	Odigie
Tabea Felicitas	Graszynski

Group 3 – gammaH2AX

Anna	Gottwald
Ryosuke	Sato
Ömer	Dağkazanli
Eurico	Pereira
Eva	Salaga
Dmitri	Suatiagin
Milou	van Beek
Matisse	Valcke

Group 4 - micronuclei

Irina	Danilova
Robin	Vanhoeijen
Jana	Trad
Roman	Kuczma
Waldemar	Vogel
Verena	Wellmann
Laetitia	Wieken
Fanny	Hedbom

Presentations on Friday 22 November

Group 1: Dosimetry
Group 2: Dicentrics and FISH
Group 3: gH2AX
Group 4: Micronuclei