A CONCERT short course entitled:

CELOD: Cellular effects of ionising radiation – introduction to radiation biology

Stockholm University, Sweden
29.04.2019 – 10.05 2019

Version 1 – 2018 09 30

Aim of the course

The aim of the course is to acquaint students with the state of the art of cellular effects of ionising radiation which are of relevance for 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 bio-logical 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 doses of ionising radiation as well as on techniques to detect them using cytogenetics and immunogenetics.
The practical part will focus on teaching the classical laboratory techniques used to study genotoxic radiation effects on cells: harvesting cells and analysing chromosomal aberrations by the Giemsa methods and in situ hybridization with whole chromosome probes as well as the gamma H2AX focus assay. Students will also be acquainted with basics of dosimetry.
The course will last 2 weeks and will be nested in a 10 week "introduction to radiobiology" course held at the Stockholm University (SU). The regular SU course is held for a maximum of 12 students. CELOD will harbour a maximum of additional 12 students, bringing the total number of participants to 24.

Information for applicants: The course is open to any postgraduate student or researcher working in an EU academic institution, aged 35 years or below. There is no course fee and every student will receive a financial support equivalent to 30 Euro per day to cover the costs of logging. The University has no logging possibilities so logging will be offered in a youth hostel. Alternatively, the applicant can find her/his own logging but the sum of financial support will remain 30 Euro per night. No other financial support will be provided.
People wishing to apply should submit by mail the following documents to Andrzej Wojcik at andrzej.wojcik@su.se:
1. A letter of application
2. A CV with a description of the scientific career
3. A supporting letter from the supervisor/head of laboratory

The **deadline for applications is February 24th 2019**. Information confirming the acceptance will be sent by Wednesday 27th February. A diploma, equivalent to 3 ECTS points, will be issued to each participant after the course.

Course description

To facilitate work in the lab the students will be divided into 4 groups with 6 people per group. 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 (except Wednesday May 1st). 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 to expose cells to X-rays, gamma rays and alpha particles. Students will work with low activity gamma radiation sources and sensitive radiation detectors. They will measure dose rates in air as a function of distance from the source (aim: demonstration of the inverse square low), energy spectra of various gamma emitting isotopes, gamma radiation build up from disintegration of radon gas. Finally, they will see how alpha radiation activates a light-emitting phosphorous sheet.

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 TK6 cells (aberrations) and with VH10 cells (gamma H2AX). The cell lines/techniques are established and currently used in our laboratory.

A detailed description of the course is given below. Lectures start at 09:00.

Monday - day 1 (29 April 2019) – lecture room P216
Morning lecture: Radiation-induced chromosomal aberrations (1.5 h) – Christian Johannes, Germany
Morning lecture: DNA damage and repair following irradiation of cells (1.5 h) – Penny Jeggo, UK
Afternoon: Group 1 learns gammaH2AX, Group 3 learns chromosomal aberrations
Groups 2 and 4: analysis of experimental results in lab D342

Tuesday – day 2 (30 April 2019) – lecture room P216
Morning lecture: Radiation effects on the immune system (1.5 h) – Udo Gaipl, Germany
Morning lecture: Bystander effects of radiation (1.5 h) – Munira Kadhim, UK
Afternoon: Group 2 learns dosimetry, Group 4 learns FISH
Groups 1 and 3: analysis of experimental results in lab D342

Wednesday – day 3 (1 May 2019) – free day

Thursday – day 4 (2 May 2019) – lecture room P216
Morning lecture: Factors which influence cellular radiosensitivity (1.5 h) – Lovisa Lundholm, Sweden
Morning lecture: High throughput analyses in radiation research (1.5 h) – Joanna Polańska, Poland
Afternoon: Group 2 learns gammaH2AX, Group 4 learns chromosomal aberrations
Groups 1 and 3: analysis of experimental results in lab D342

Friday – day 5 (3 May 2019) – lecture room P216
Morning lecture: Radiation-induced micronuclei (1.5 h) – Anne Vral, Belgium
Morning lecture: Radiation-induced gammaH2AX foci (1.5 h) – Harry Scherthan, Germany
Afternoon: Group 3 learns dosimetry, Group 1 learns FISH.
Groups 2 and 4: analysis of experimental results in lab D342.

Saturday a one day trip to Uppsala with a visit to scientific museums and an evening reception at SU

Monday – day 6 (6 May 2019)
Morning: Group 1 learns chromosomal aberrations, group 3 learns gamma-H2AX (3h). Other groups analyse experimental results in D342.
Afternoon: All groups: analysis of experimental results in lab D342.

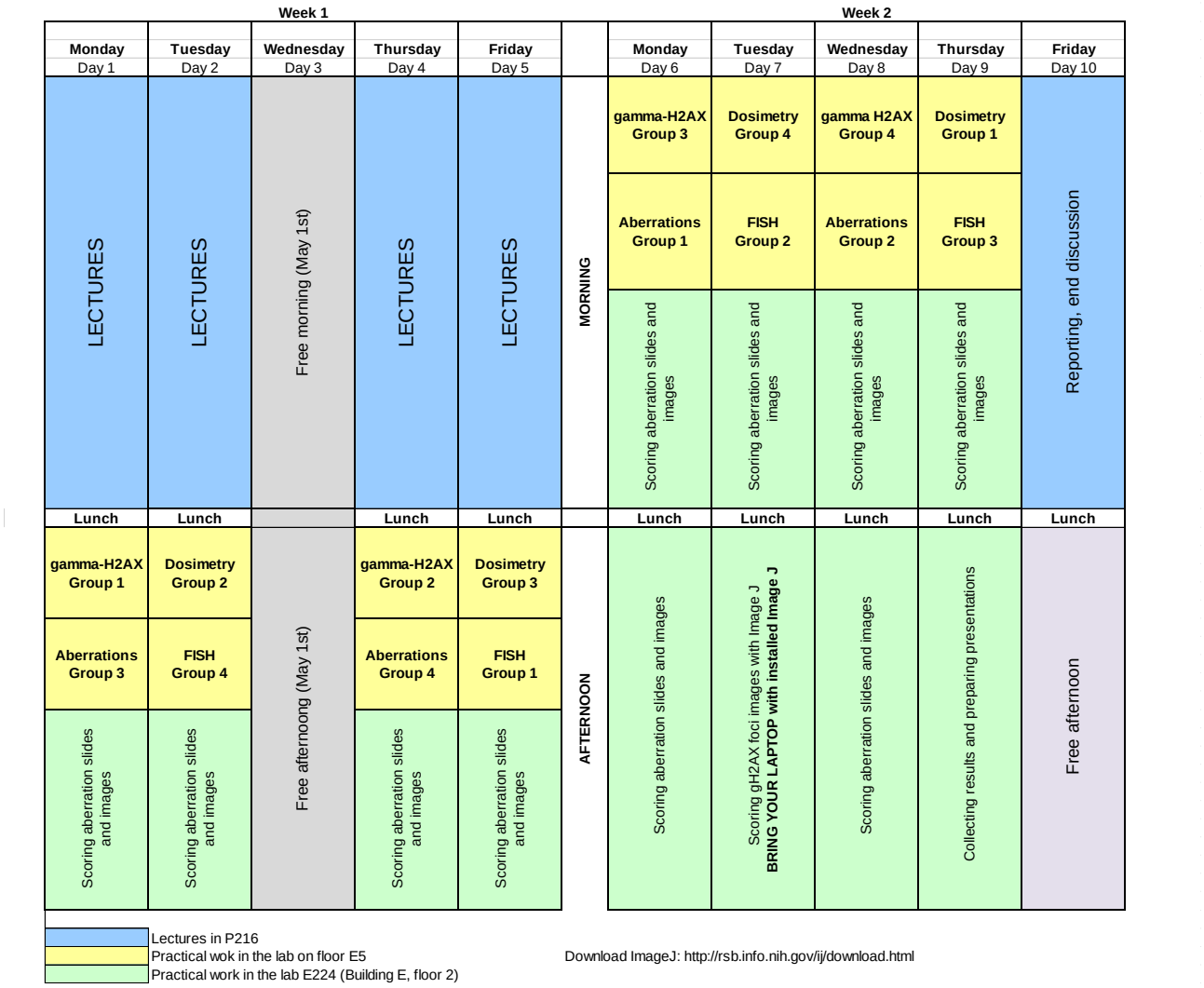
Tuesday – day 7 (7 May 2019)
Morning: Group 2 learns FISH, Group 4 learns dosimetry (3h). Other groups analyse experimental results in lab D342.
Afternoon: All groups: scoring of gamma H2AX foci images with Image J in lab D342. BRING YOUR LAPTOP with installed Image J.

Wednesday – day 8 (2 May 2019)
Morning: Group 4 learns FISH, group 2 learns dosimetry (3h). Other groups analyse experimental results in lab D342.
Afternoon: All groups: analysis of experimental results in lab D342.

Thursday – day 9 (3 May 2018)
Morning: Group 3 learns FISH, group 4 learns dosimetry (3h). Other groups collect results and prepare presentations.
Afternoon: All groups collect results and prepare presentations. (5h).

Friday – day 10 (4 May 2018)
Morning: presentation of results, general discussion (4h) in room D508.

A diagram illustrating the timing of CELOD components is shown below. Blue: lectures/seminars, yellow: experimental work in the lab, green: scoring of slides/images.



Groups

Group 1	Group 2	Group 3	Group 4

Files and more info at: http://www.crpr-su.se/CELOD/