Universitat Autònoma de Barcelona

**2021/2022**

# Molecular Biology of Cancer

Code: 100863
ECTS Credits: 6

| Degree | Type | Year | Semester |
|---|---|---|---|
| 2500252 Biochemistry | OT | 4 | 0 |

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

## Contact

Name: Carles Arús Caralto
Email: Carles.Arus@uab.cat

## Use of Languages

Principal working language: english (eng)
Some groups entirely in English: Yes
Some groups entirely in Catalan: No
Some groups entirely in Spanish: No

## Other comments on languages

Teachers can interact with students in Catalan, Spanish or English. All contributions submitted for evaluation in English language will produce a bonus. This bonus will multiply the numerical grade obtained by a factor between 1 (minimum) and 1.1 (maximum)

## Teachers

Anna Maria Bassols Teixidó

David Garcia Quintana

## Prerequisites

No specific requirements. Still, it is advisable that exchange students have succesfully completed already 2 full academic years at their originating institution. Most reference literature is in the English language, which is also used in the figures projected in theory classes. Furthermore, oral communication in English will be used when the student addresses the teacher in this language.

## Objectives and Contextualisation

The hallmarks of cancer with respect to normal tissues and the molecular and cellular basis of those differences will be described. The relevance of deregulation of basal properties of tissues, such as cellular proliferation or controlled death processes will be emphasized. Their effects in tumour progression, be it through genetic (i.e. mutations) or epigenetic changes (i.e. angiogenesis, tumour microenvironment, extracellular proteolysis deregulation) will be considered. Finally, the molecular basis of new therapies will be analysed.

## Competences

- Apply the principal techniques used in biological systems: methods of separation and characterisation of biomolecules, cell cultures, DNA and recombinant protein techniques, immunological techniques, microscopy techniques, etc.
- Collaborate with other work colleagues.
- Describe intercellular and intracellular communication systems that regulate the proliferation, differentiation, development and function of animal and plant tissues and organs.
- Design experiments and understand the limitations of experimental approaches.
- Display knowledge of the biochemical and genetic changes that occur in many pathologies and explain the molecular mechanisms involved in these changes.
- Interpret experimental results and identify consistent and inconsistent elements.
- Manage information and the organisation and planning of work.
- Read specialised texts both in English and ones own language.
- Take responsibility for one's own learning after receiving general instructions.
- Think in an integrated manner and approach problems from different perspectives.
- Understand the language and proposals of other specialists.
- Use ICT for communication, information searching, data processing and calculations.
- Write an article on a scientific or technical topic aimed at the general public.

## Learning Outcomes

1. Collaborate with other work colleagues.
2. Describe the different signal transduction pathways involved in cancer.
3. Describe the genes involved in the control of the cell cycle, and how CDC mutants are identified.
4. Describe the molecular bases of cancer and its clonal and sequential process.
5. Describe the regulation of the cell cycle and its modulation.
6. Design experiments and understand the limitations of experimental approaches.
7. Determine the percentage of stem cells in a tumour population.
8. Evaluate research into new molecular-based therapies.
9. Explain the concepts of tumour progression, hypoxia and angiogenesis, participation of the tumour environment, migration and molecular bases of metastasis.
10. Explain the mechanisms for monitoring damage to DNA and the repair paths.
11. Interpret experimental results and identify consistent and inconsistent elements.
12. Interpret the role of accumulation of mutations versus genomic instability and Darwinian selection.
13. Manage information and the organisation and planning of work.
14. Read specialised texts both in English and ones own language.
15. Relate non-coding RNAs and cancer.
16. Relate oncogenes and tumour-suppressor genes.
17. Relate the process of apoptosis, the role of telomerase in immortalisation, and the concept of stem cells of the tumour.
18. Take responsibility for one's own learning after receiving general instructions.
19. Think in an integrated manner and approach problems from different perspectives.
20. Understand the language and proposals of other specialists.
21. Use ICT for communication, information searching, data processing and calculations.
22. Write an article on a scientific or technical topic aimed at the general public.

## Content

Chapter list(*)

Chapter 1. The nature of cancer. Types of tumours. Clonal selection and tumour progression. Driver, passenger and neutral mutations. Hallmarks of cancer: required competences for cells to become tumoral. Viruses, mutations and cancer.

Chapter 2. Oncogens. Mechanisms for the activation of oncogenes. Oncogens and Proto-oncogens. What are oncogens: growth factors, receptors, transductors, transcription factors.

Chapter 3. Tumour suppressor genes (TSG). General features. The Knudson hypothesis. Examples of TSG: Rb, NF1, APC, VHL, p53.

Chapter 4 (teaching in English). Loss of cell cycle control and genomic instability. Tumour cells are independent of pro-proliferation signalling and growth suppressors: myc, pRB, E2F and restriction point control. Tumour cells are (need to be) genomically unstable: Darwinian evolution in cancer. Surveillance mechanisms: critical barriers in malignant transformation.

Chapter 5. Genomics and transcriptomics of cancer. Role of DNA lesions, types of mutagens and their activation path, surveillance mechanisms and repair pathways. Epigenetics aspects of malignant transformation, promotors. Non-coding RNAs and cancer. Role of massive genome sequencing and of tumoral transcriptomics in the understanding of tumour progression.

Chapter 6. Stem cells and deregulation of cell death. Tumour stem cells or tumour initiating cells, hierarchy and niches, differentiation. Senescence, telomerase and inmortalization. Apoptosis and Necrosis.

Chapter 7. Tumour progression. Stages in progression. Hypoxia and angiogénesis. Reprogramming of tumour metabolism. Role of tumour microenvironment, pHe, inflammation, heterotypic interactions in tumours. Molecular basis of invasion, directional migration and metastasis.

Chapter 8. Molecular basis of new antitumour therapies. Classical therapies. The resistance problem. The problem of adequate models. The problem of biomarkers of response. Rational drug design. Anti-angiogenic therapy. Immunotherapy. Oncolitic viruses. Re-differentiation therapy. Therapy against tumour initiating cells.

Laboratory work. Three sessions for each lab group. Lab work with cultured tumour cell lines. Response and resistance to therapy.

*Unless the requirements enforced by the health authorities demand a prioritization or reduction of these contents.

## Methodology

* Theory and guided problem-solving classes. Emphasis will be placed in the learning performance of students. Such learning performance will be actively fostered by teachers by providing gradings for the homework and problem solving tasks performed by students (see evaluation strategy section). Laboratory work (3 sessions) will be performed in 2-3 people groups.

*The proposed teaching methodology may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

## Activities

| Title | Hours | ECTS | Learning Outcomes |
|---|---|---|---|
| Type: Directed | | | |
| Laboratory work | 12 | 0.48 | 21, 1, 6, 20, 13, 11, 14, 19, 7 |
| Problems based teaching | 13 | 0.52 | 21, 6, 20, 13, 11, 14, 19, 7 |
| Theory classes | 26 | 1.04 | 9, 3, 5, 4, 2, 20, 10, 12, 7, 15, 17, 16, 8 |

| | | | |
|---|---|---|---|
| Type: Supervised | | | |
| Homework delivery and associated interaction through "Campus Virtual" | 14 | 0.56 | 21, 1, 22, 11, 14, 18 |
| Tutor supervision | 2 | 0.08 | 20, 13 |
| Type: Autonomous | | | |
| Information retrieval, study, processing of gathered information and electronic delivery of supervised homework through "Campus Virtual" | 46.5 | 1.86 | 9, 21, 1, 3, 5, 4, 2, 22, 20, 10, 13, 11, 14, 19, 7, 15, 17, 16, 18, 8 |
| Solving problems | 10 | 0.4 | 9, 21, 1, 3, 5, 4, 2, 20, 10, 12, 11, 14, 19, 7, 15, 16, 18, 8 |
| Studying for exams | 10 | 0.4 | 20, 13, 11, 14, 19, 18 |
| Writing the laboratory work report | 6 | 0.24 | 21, 6, 20, 13, 14, 19, 18 |

## Assessment

(*) - All contributions submitted for evaluation in English language will produce a bonus. This bonus will multiply the numerical grade obtained by a factor between 1 (minimum) and 1.1 (maximum).

- The percentage contribution to the global evaluation will be: 51% supervised participative homework and problem solving evaluation, 10% Laboratory work evaluation and delivery of the lab work report, 39 % partial exams.

- Exams: There will be two partial exams. The first partial will be after chapter 4, and the second one, after chapter 8. Final exam grade will be the weighed average of the two partial exam grades (first partial weighs 1/3 and second partial weighs 2/3). The exams will allow unlimited access to course related information, books, class notes, computer and Internet.

- Continuous work performance evaluation. There will be 2-3 homework reports to be delivered during the course. Such homework may be of the type of: problem solving, publication data interpretation, literature search, seminar delivery, etc. Every teacher in charge will propose the homework subject through the "Campus Virtual" interactive tools. In case written deliveries are requested, both electronic and printed submission within the allocated time frame will be mandatory. Homework may be individual or in small groups, according to the teacher instructions in each instance. The contribution of each "homework" to the 51% will be the same.

- Revision of grades. A revision date and time frame will be announced after each written partial exam. Furthermore, grades for other course work will appear periodically all along the course at the "Campus Virtual". There will be at least 3 time frames for revision offered during the course. Day and time frame for grade revision will be duly advertised at "Campus Virtual" at least 48 hours prior to the starting revision time, and also at class time.

- As for the grading strategy, all homework and supervised work handed in for evaluation will be considered individual items contributing the global evaluation section of the course (51% of the total grading).

- Students not able to attend an evaluation exam due to relevant conditions (illness, family death, accident) and deliver valid proof of such condition to the teacher/degree Coordinator, will be allowed to perform the missing evaluation at a different date. The degree coordinator will oversee this in case of need to secure an adequate date for performing the additional evaluation.

- To be able to attend the laboratory work sessions the student should provide proof of successful evaluation of lab security and biosecurity conditions available through "Campus Virtual". Furthermore, he/she should be aware and accept the rules for access and work at the laboratories of the Faculty of Biosciences.

- Retake process description. To be eventually eligible for the application of the retake process for final grading, the student should have been evaluated in a set of activities equaling at least two thirds of the final score of the course or module. Thus, the student will be graded as "No Avaluable" (Not Assessable) if the weighting of all conducted evaluation activities, before application of the retake evaluation derived grades, is less than 67% of the final score. Any grade obtained in the activities identified as "retake activities" will substitute the grade obtained in the previous activity that the retake activity is substituting, independently of the previous grade being lower or higher than the retake grade. The retake session will be applied to grade producing activities equivalent at least to 50% of the final score. Namely, the specific items involved in the retake process will substitute the grade derived from exams 1 and 2 (39% of the global grade) and part of the grade derived from the participative and lab work (11% of the global grade, problems+homework+lab work evaluation). The retake activity will allow access to all course related materials during the retake activity, including internet access. To avoid unnecessary printing of grading materials or reserving spaces for retake sessions not actually needed, there will be a 48 hours period prior to the retake activity for students to declare their interest in attending the retake session. Only students having declared interest in attending the retake session through the Campus Virtual before the 48 hours deadline will be admitted to the retake activity. In case no student requests to participate, the retake session will be cancelled.

*Student's assessment may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.

## Assessment Activities

| Title | Weighting | Hours | ECTS | Learning Outcomes |
|---|---|---|---|---|
| Delivery of the laboratory work report | 10% | 0.5 | 0.02 | 21, 1, 6, 20, 13, 11, 14, 19, 18 |
| Homework delivery, problems evaluation and associated interaction through "Campus Virtual" | 51% | 6 | 0.24 | 21, 1, 6, 22, 20, 13, 14, 19, 7, 18 |
| Partial exams | 39% | 4 | 0.16 | 9, 3, 5, 4, 2, 20, 10, 12, 11, 19, 15, 17, 16, 8 |

## Bibliography

Reference books

1. The Biology of Cancer, 2nd Edition. Robert A. Weinberg, 2014, Garland Science, NY, USA.

2. Molecular and Cell Biology of Cancer. Rita Fior, Rita Zilhão Editors, 2019, Springer, eBook available at the UAB library system.

3. Molecular Cell Biology. Harvey Lodish et al. 7th Edition, 2012, Freeman and Co., NY, USA.

4. Molecular Biology of the Cell. Bruce Alberts et al. 5th Edition, 2008, Garland Science, NY, USA

## Software

None