



## Teaching Guide

| Teaching Guide           |                                                                        |        |                    |           |
|--------------------------|------------------------------------------------------------------------|--------|--------------------|-----------|
| Identifying Data         |                                                                        |        |                    | 2018/19   |
| Subject (*)              | Stem Cells and Cell Therapy                                            |        | Code               | 610441009 |
| Study programme          | Mestrado Universitario en Biología Molecular , Celular e Xenética      |        |                    |           |
| Descriptors              |                                                                        |        |                    |           |
| Cycle                    | Period                                                                 | Year   | Type               | Credits   |
| Official Master's Degree | 2nd four-month period                                                  | First  | Optional           | 3         |
| Language                 | SpanishGalicianEnglish                                                 |        |                    |           |
| Teaching method          | Face-to-face                                                           |        |                    |           |
| Prerequisites            |                                                                        |        |                    |           |
| Department               | Ciencias Biomédicas, Medicina e Fisioterapia                           |        |                    |           |
| Coordinador              | Arufe Gonda, María del Carmen                                          | E-mail | maria.arufe@udc.es |           |
| Lecturers                | Arufe Gonda, María del Carmen                                          | E-mail | maria.arufe@udc.es |           |
| Web                      |                                                                        |        |                    |           |
| General description      | Subject´s coordinador :María del Carmen Arufe Gonda maria.arufe@udc.es |        |                    |           |
|                          | Teachers from INIBIC:                                                  |        |                    |           |
|                          | Dr. Fco. Javier Blanco García (fblagar@sergas.es)                      |        |                    |           |
|                          | Dra. Nieves Domenech García (nieves.domenech.garcia@sergas.es)         |        |                    |           |
|                          | Dra. Mª Esther Rendal Vázquez                                          |        |                    |           |

## Study programme competences

| Code | Study programme competences                                                                                                                                                                                              |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A1   | Skills of using usual techniques and instruments in the cellular, biological and molecular research: that are able to use techniques and instruments as well as understanding potentials of their uses and applications. |
| A2   | Skills of working in a sure way in the laboratories knowing operation handbooks and actions to avoid incidents of risk.                                                                                                  |
| A6   | Skills of understanding the functioning of cells through the structural organization, biochemistry, gene expression and genetic variability.                                                                             |
| A7   | Skills of knowing and analyzing specific cellular systems as stem cells, nerve cells, cells of the immune system, or other cells related to several pathologies.                                                         |
| A8   | Skills of having an integrated view of the previously acquired knowledge about Molecular and Cellular Biology and Genetics, with an interdisciplinary approach and experimental work.                                    |
| B1   | Analysis skills to understand biological problems in connection with the Molecular and Cellular Biology and Genetics.                                                                                                    |
| B3   | Skills of management of the information: that are able to gather and to understand relevant information and results, obtaining conclusions and to prepare reasoned reports on scientific and biotechnological questions  |
| B4   | Organization and work planning skills: that are able to manage the use of the time as well as available resources and to organize the work in the laboratory.                                                            |
| B8   | Critical reasoning skills and ethical commitment with the society: sensitivity in front of bioethical problems and to the ones related to the natural resource conservation                                              |
| C1   | Skills of expressing correctly, so much of oral form as written, in the official languages of the autonomous region.                                                                                                     |
| C6   | Considering critically the knowledge, technologies and the available information to solve problems with which should face.                                                                                               |
| C8   | Considering the importance that the investigation has, the innovation and the technological development in the socioeconomic advance and cultural of the society.                                                        |

## Learning outcomes

| Learning outcomes | Study programme competences |
|-------------------|-----------------------------|
|-------------------|-----------------------------|



|                                  |     |     |     |
|----------------------------------|-----|-----|-----|
| The study of cellular techniques | AR1 | BR1 | CC1 |
|                                  | AR2 | BR3 | CC6 |
|                                  | AR6 | BR4 | CC8 |
|                                  | AR7 | BR8 |     |
|                                  | AR8 |     |     |

| Contents                             |                                                                                                                                                                                    |
|--------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Topic                                | Sub-topic                                                                                                                                                                          |
| Introduction                         | Culture area for cell therapy.<br>Stem cells and therapy basic cell.<br>Embryonic stem cells and therapeutic cloning.                                                              |
| Search cell sources for cell therapy | Obtaining mesenchymal stem cells from umbilical strome.<br>Cell therapy in cartilage recovery.<br>Cell therapy in myocardial recovery.<br>Culture of ocular limbal cells to repair |
| Tissue Engineering                   | Transplantation of tissue-engineered skin produced.<br>Scaffolds and Biopolymers in tissue engineering.                                                                            |

| Planning                       |                      |                      |                               |             |
|--------------------------------|----------------------|----------------------|-------------------------------|-------------|
| Methodologies / tests          | Competencies         | Ordinary class hours | Student?s personal work hours | Total hours |
| Guest lecture / keynote speech | A1 A2 B1 B3 B4 C6 C8 | 12                   | 30                            | 42          |
| Laboratory practice            | B4 B8 C1 C6 C8       | 7                    | 0                             | 7           |
| Seminar                        | C6 C8                | 1                    | 7                             | 8           |
| Objective test                 | A6 A7 A8 C1 C6       | 1                    | 17                            | 18          |
| Personalized attention         |                      | 0                    | 0                             | 0           |

(\*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

| Methodologies                  |                                                                                                                            |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------|
| Methodologies                  | Description                                                                                                                |
| Guest lecture / keynote speech | Lecture participatory, encouraging the exchange of views, debate and answer questions from students.                       |
| Laboratory practice            | They unfold techniques currently used in biomedical research, complementing the knowledge imparted in the keynote session. |
| Seminar                        | Invitation some scientist to show us her most recent research.                                                             |
| Objective test                 | Multiple choice exam in which each question consists of 4 claims of which only one is correct.                             |

| Personalized attention         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Methodologies                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Guest lecture / keynote speech | Being a small group of students, it is possible to resolve doubts and individualized monitoring during the learning process itself.                                                                                                                                                                                                                                                                                                                                                            |
| Laboratory practice            | In particular, the master class is participatory, encouraging the exchange of opinions, debate and answer questions.<br>The students in labs are supervised at all times by teachers and, if necessary, by the research group in which the student integrates.<br>Students with part-time dedication or waiver of presence should contact the teachers of the subject in the early going to establish a schedule of activities to acquire and evaluate in a complementary way the competences. |

| Assessment |
|------------|
|------------|



| Methodologies                  | Competencies         | Description                                                                                                     | Qualification |
|--------------------------------|----------------------|-----------------------------------------------------------------------------------------------------------------|---------------|
| Guest lecture / keynote speech | A1 A2 B1 B3 B4 C6 C8 | Attendance and participation                                                                                    | 15            |
| Objective test                 | A6 A7 A8 C1 C6       | Questions about the theory and methodology used in the class.                                                   | 40            |
| Seminar                        | C6 C8                | Reading and discussion commented. This activity will be assessed the acquisition of skills A18, B1, B3, B4, B8. | 15            |
| Laboratory practice            | B4 B8 C1 C6 C8       | Attendance and participation.<br>This activity will be assessed the acquisition of skills A3, A4, A6, A9, A10   | 30            |

#### Assessment comments

Students with part-time dedication or waiver attendance may choose to be evaluated in a final exam if they do not qualify for continuous evaluation.

#### Sources of information

Basic



Complementary

1 Lawrence, R. C. et al. Estimates of the prevalence of arthritis and other rheumatic conditions in the United States. Part II. *Arthritis Rheum* 58, 26-35, doi:10.1002/art.23176 (2008). 2 Arufe, M. C., De la Fuente, A., Fuentes-Boquete, I., De Toro, F. J. & Blanco, F. J. Differentiation of synovial CD-105(+) human mesenchymal stem cells into chondrocyte-like cells through spheroid formation. *J Cell Biochem* 108, 145-155, doi:10.1002/jcb.22238 (2009). 3 Csaki, C., Matis, U., Mobasheri, A., Ye, H. & Shakibaei, M. Chondrogenesis, osteogenesis and adipogenesis of canine mesenchymal stem cells: a biochemical, morphological and ultrastructural study. *Histochem Cell Biol* 128, 507-520, doi:10.1007/s00418-007-0337-z (2007). 4 Carlson, C. S., Loeser, R. F., Purser, C. B., Gardin, J. F. & Jerome, C. P. Osteoarthritis in cynomolgus macaques. III: Effects of age, gender, and subchondral bone thickness on the severity of disease. *J Bone Miner Res* 11, 1209-1217 (1996). 5 Olson, E. J., Lindgren, B. R. & Carlson, C. S. Effects of long-term estrogen replacement therapy on the prevalence and area of periarticular tibial osteophytes in surgically postmenopausal cynomolgus monkeys. *Bone* 41, 282-289, doi:S8756-3282(07)00355-9 [pii] 10.1016/j.bone.2007.04.175 (2007). 6 Ham, K. D., Loeser, R. F., Lindgren, B. R. & Carlson, C. S. Effects of long-term estrogen replacement therapy on osteoarthritis severity in cynomolgus monkeys. *Arthritis Rheum* 46, 1956-1964, doi:10.1002/art.10406 (2002). 7 Tang, C. H. et al. Bone-derived SDF-1 stimulates IL-6 release via CXCR4, ERK and NF-kappaB pathways and promotes osteoclastogenesis in human oral cancer cells. *Carcinogenesis* 29, 1483-1492, doi:bgn045 [pii] 10.1093/carcin/bgn045 (2008). 8 Mateos, J. et al. Lamin A deregulation in human mesenchymal stem cells promotes an impairment in their chondrogenic potential and imbalance in their response to oxidative stress. *Stem Cell Res* 11, 1137-1148, doi:10.1016/j.scr.2013.07.004 (2013). 9 Ramallal, M. et al. Xeno-implantation of pig chondrocytes into rabbit to treat localized articular cartilage defects: an animal model. *Wound Repair Regen* 12, 337-345, doi:10.1111/j.1067-1927.2004.012309.x WRR12309 [pii] (2004). 10 Liechty, K. W. et al. Human mesenchymal stem cells engraft and demonstrate site-specific differentiation after in utero transplantation in sheep. *Nat Med* 6, 1282-1286, doi:10.1038/81395 (2000). 11 MacDonald, D. J. et al. Persistence of marrow stromal cells implanted into acutely infarcted myocardium: observations in a xenotransplant model. *J Thorac Cardiovasc Surg* 130, 1114-1121, doi:S0022-5223(05)00975-X [pii] 10.1016/j.jtcvs.2005.04.033 (2005). 12 Grinnemo, K. H. et al. Xenoreactivity and engraftment of human mesenchymal stem cells transplanted into infarcted rat myocardium. *J Thorac Cardiovasc Surg* 127, 1293-1300, doi:10.1016/j.jtcvs.2003.07.037 S0022522303015137 [pii] (2004). 13 Chen, F. H. & Tuan, R. S. Mesenchymal stem cells in arthritic diseases. *Arthritis Res Ther* 10, 223, doi:ar2514 [pii] 10.1186/ar2514 (2008). 14 Hunziker, E. B. Articular cartilage repair: basic science and clinical progress. A review of the current status and prospects. *Osteoarthritis Cartilage* 10, 432-463, doi:10.1053/joca.2002.0801 S1063458402908010 [pii] (2002). 15 Koch, T. G. & Betts, D. H. Stem cell therapy for joint problems using the horse as a clinically relevant animal model. *Expert Opin Biol Ther* 7, 1621-1626, doi:10.1517/14712598.7.11.1621 (2007). 16 Arufe, M. C., De la Fuente, A., Fuentes-Boquete, I., De Toro, F. J. & Blanco, F. J. Differentiation of synovial CD-105(+) human mesenchymal stem cells into chondrocyte-like cells through spheroid formation. *J Cell Biochem*, doi:10.1002/jcb.22238 (2009). 17 Karlsson, C., Thornemo, M., Henriksson, H. B. & Lindahl, A. Identification of a stem cell niche in the zone of Ranvier within the knee joint. *J Anat*, doi:JOA1115 [pii] 10.1111/j.1469-7580.2009.01115.x (2009). 18 Grogan, S. P., Miyaki, S., Asahara, H., D'Lima, D. D. & Lotz, M. K. Mesenchymal progenitor cell markers in human articular cartilage: normal distribution and changes in osteoarthritis. *Arthritis Res Ther* 11, R85, doi:ar2719 [pii] 10.1186/ar2719 (2009). 19 Isakova, I. A., Baker, K., Dufour, J., Gaupp, D. & Phinney, D. G. Preclinical evaluation of adult stem cell engraftment and toxicity in the CNS of rhesus macaques. *Mol Ther* 13, 1173-1184, doi:S1525-0016(06)00012-8 [pii] 10.1016/j.ymthe.2005.12.014 (2006). 20 Mundy, G. R. Metastasis to bone: causes, consequences and therapeutic opportunities. *Nat Rev Cancer* 2, 584-593, doi:10.1038/nrc867 nrc867 [pii] (2002). 21 Taichman, R. S. et al. Use of the stromal cell-derived factor-1/CXCR4 pathway in prostate cancer metastasis to bone. *Cancer Res* 62, 1832-1837 (2002). 22 Heng, B. C. et al. Trans-Catheter Injection Induced Changes in Human Bone Marrow-Derived Mesenchymal Stem Cells. *Cell Transplant*, doi:ct2093heng [pii] 10.3727/096368909X12483162197006 (2009). 1 Lawrence, R. C. et al. Estimates of the prevalence of arthritis and other rheumatic conditions in the United States. Part II. *Arthritis Rheum* 58, 26-35, doi:10.1002/art.23176 (2008). 2 Arufe, M. C., De la Fuente, A., Fuentes-Boquete, I., De Toro, F. J. & Blanco, F. J. 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and ultrastructural study. *Histochem Cell Biol* 128, 507-520, doi:10.1007/s00418-007-0337-z (2007). 4 Carlson, C. S., Loeser, R. F., Purser, C. B., Gardin, J. F. & Jerome, C. P. Osteoarthritis in cynomolgus macaques. III: Effects of age, gender, and subchondral bone thickness on the severity of disease. *J Bone Miner Res* 11, 1209-1217 (1996). 5 Olson, E. J., Lindgren, B. R. & Carlson, C. S. Effects of long-term estrogen replacement therapy on the prevalence and area of periarticular tibial osteophytes in surgically postmenopausal cynomolgus monkeys. *Bone* 41, 282-289, doi:S8756-3282(07)00355-9 [pii] 10.1016/j.bone.2007.04.175 (2007). 6 Ham, K. D., Loeser, R. F., Lindgren, B. R. & Carlson, C. S. Effects of long-term estrogen replacement therapy on osteoarthritis severity in cynomolgus monkeys. *Arthritis Rheum* 46, 1956-1964, doi:10.1002/art.10406 (2002). 7 Tang, C. H. et al. Bone-derived SDF-1 stimulates IL-6 release via CXCR4, ERK and NF-kappaB pathways and promotes osteoclastogenesis in human oral cancer cells. *Carcinogenesis* 29, 1483-1492, doi:bgn045 [pii] 10.1093/carcin/bgn045 (2008). 8 Mateos, J. et al. Lamin A deregulation in human mesenchymal stem cells promotes an impairment in their chondrogenic potential and imbalance in their response to oxidative stress. *Stem Cell Res* 11, 1137-1148, doi:10.1016/j.scr.2013.07.004 (2013). 9 Ramallal, M. et al. Xeno-implantation of pig chondrocytes into rabbit to treat localized articular cartilage defects: an animal model. *Wound Repair Regen* 12, 337-345, doi:10.1111/j.1067-1927.2004.012309.x WRR12309 [pii] (2004). 10 Liechty, K. W. et al. Human mesenchymal stem cells engraft and demonstrate site-specific differentiation after in utero transplantation in sheep. *Nat Med* 6, 1282-1286, doi:10.1038/81395 (2000). 11 MacDonald, D. J. et al. Persistence of marrow stromal cells implanted into acutely infarcted myocardium: observations in a xenotransplant model. *J Thorac Cardiovasc Surg* 130, 1114-1121, doi:S0022-5223(05)00975-X [pii] 10.1016/j.jtcvs.2005.04.033 (2005). 12 Grinnemo, K. H. et al. Xenoreactivity and engraftment of human mesenchymal stem cells transplanted into infarcted rat myocardium. *J Thorac Cardiovasc Surg* 127, 1293-1300, doi:10.1016/j.jtcvs.2003.07.037 S0022522303015137 [pii] (2004). 13 Chen, F. H. & Tuan, R. S. Mesenchymal stem cells in arthritic diseases. *Arthritis Res Ther* 10, 223, doi:ar2514 [pii] 10.1186/ar2514 (2008). 14 Hunziker, E. B. Articular cartilage repair: basic science and clinical progress. A review of the current status and prospects. *Osteoarthritis Cartilage* 10, 432-463, doi:10.1053/joca.2002.0801 S1063458402908010 [pii] (2002). 15 Koch, T. G. & Betts, D. H. Stem cell therapy for joint problems using the horse as a clinically relevant animal model. *Expert Opin Biol Ther* 7, 1621-1626, doi:10.1517/14712598.7.11.1621 (2007). 16 Arufe, M. C., De la Fuente, A., Fuentes-Boquete, I., De Toro, F. J. & Blanco, F. J. Differentiation of synovial CD-105(+) human mesenchymal stem cells into chondrocyte-like cells through spheroid formation. *J Cell Biochem*, doi:10.1002/jcb.22238 (2009). 17 Karlsson, C., Thorne, M., Henriksson, H. B. & Lindahl, A. Identification of a stem cell niche in the zone of Ranvier within the knee joint. *J Anat*, doi:JOA1115 [pii] 10.1111/j.1469-7580.2009.01115.x (2009). 18 Grogan, S. P., Miyaki, S., Asahara, H., D'Lima, D. D. & Lotz, M. K. Mesenchymal progenitor cell markers in human articular cartilage: normal distribution and changes in osteoarthritis. *Arthritis Res Ther* 11, R85, doi:ar2719 [pii] 10.1186/ar2719 (2009). 19 Isakova, I. A., Baker, K., Dufour, J., Gaupp, D. & Phinney, D. G. Preclinical evaluation of adult stem cell engraftment and toxicity in the CNS of rhesus macaques. *Mol Ther* 13, 1173-1184, doi:S1525-0016(06)00012-8 [pii] 10.1016/j.ymthe.2005.12.014 (2006). 20 Mundy, G. R. Metastasis to bone: causes, consequences and therapeutic opportunities. *Nat Rev Cancer* 2, 584-593, doi:10.1038/nrc867 nrc867 [pii] (2002). 21 Taichman, R. S. et al. Use of the stromal cell-derived factor-1/CXCR4 pathway in prostate cancer metastasis to bone. *Cancer Res* 62, 1832-1837 (2002). 22 Heng, B. C. et al. Trans-Catheter Injection Induced Changes in Human Bone Marrow-Derived Mesenchymal Stem Cells. *Cell Transplant*, doi:ct2093heng [pii] 10.3727/096368909X12483162197006 (2009).



| Recommendations                                          |
|----------------------------------------------------------|
| Subjects that it is recommended to have taken before     |
| Cellular Techniques/610441001                            |
| Subjects that are recommended to be taken simultaneously |
| Molecular Techniques/610441002                           |
| Subjects that continue the syllabus                      |
| Advanced Cellular Biology/610441003                      |
| Other comments                                           |
|                                                          |

(\*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.