DEPARTMENT OF MEDICINE, HUDDINGE

H7F6092, Next-Generation Cell and Gene Therapies: Cancer and Beyond, 1.5 credits (hec)

Framtidens cell- och genterapier: cancer och vidare tillämpningar, 1,5 högskolepoäng

Third-cycle level / Forskarnivå

Approval

This syllabus was approved by The Committee for Doctoral Education on 2025-09-13, and is valid from spring semester 2026.

Responsible department

Department of Medicine, Huddinge, Faculty of Medicine

Prerequisite courses, or equivalent

Knowledge and/or skills in Immunology, Molecular Biology or Cancer Biology, equivalent to course Basic Immunology or Tumor Immunology or corresponding courses.

Purpose & Intended learning outcomes

Purpose

The purpose of this course is to provide an in-depth understanding of next-generation cell and gene therapies and their potential to transform the treatment of cancer and other complex diseases. The course will begin by introducing the scientific foundations of cellular engineering, gene editing, and immunotherapy, offering participants a broad perspective on how these technologies have evolved. It will then focus on current developments in the field, including CAR-T cells, tumor-infiltrating lymphocytes, gene-modified hematopoietic stem cells, and emerging in vivo gene editing strategies. Special emphasis will be placed on the challenges of translation to the clinic, such as treatment resistance, safety, scalability, and regulatory considerations. Finally, the course will explore future directions in the development of cell and gene therapies, highlighting their potential to reshape personalized medicine and expand therapeutic options for patients with cancer and other difficult-to-treat diseases.

Intended learning outcomes

After completing this course, the participant is expected to be able to:

1. Explain the fundamental principles of next-generation cell and gene therapies and their relevance for cancer and other complex diseases.
2. Analyze and compare key therapeutic platforms—including engineered immune cells, gene-modified stem cells, and in vivo gene editing—and evaluate their mechanisms of action.
3. Discuss the major scientific, clinical, and regulatory challenges associated with developing and translating these therapies into safe and effective treatments.
4. Integrate cutting-edge concepts and approaches in cell and gene therapy into their own research or professional practice.

Course content

This course provides participants with an advanced understanding of next-generation cell and gene therapies and their transformative potential in the treatment of cancer and other complex diseases. Beginning with an overview of the scientific foundations of cellular and genetic engineering, the course will trace the evolution of these technologies from early concepts to state-of-the-art therapeutic approaches. Participants will then explore key modalities such as CAR-T cell therapy, engineered natural killer cells, tumor-infiltrating lymphocytes, gene-edited stem cells, and in vivo gene editing strategies. The course will highlight not only the biological mechanisms and therapeutic promise of these approaches, but also the major challenges they face, including resistance, safety, manufacturing scalability, and regulatory hurdles. Finally, the course will look ahead to future innovations, discussing how advances in synthetic biology, precision medicine, and genome engineering are shaping the next wave of treatments for cancer and beyond.

Forms of teaching and learning

The pedagogic frame of this course is based on lectures combined with topic-related research articles and learning activities such as small group discussions, 1-minute reflections, quizzes and similar exercises that shall foster student-centered learning. The course includes workshops where the students are requested to present articles, integrate the knowledge acquired from lectures and reading of the articles, and actively discuss their acquired knowledge in small groups. Each student will research, prepare, and present his or her examination task orally.

Language of instruction

The course is given in English

The language of the course is english.

Grading scale

Pass (G) /Fail (U)

The grading is pass/fail.

Compulsory components & forms of assessment

Compulsory components

The lectures and discussions are mandatory. Absence is compensated according to agreements with the course director

Forms of assessment

The individual assessment of each student will be conducted based on their presentation of a topic related to cell and gene engineering, as well as on the constructive feedback they provide to their peers. The content and organization of the presentation and discussion will follow a format provided by the instructors.

Course literature

The course literature will consist of recent articles on selected topics within the field of cell and gene therapy. These will be updated prior to the course based on speakers for the course and current publications. Examples of recommended articles:

"Engineering the next generation of cell-based therapeutics" (2022) https://pmc.ncbi.nlm.nih.gov/articles/PMC9149674/

"Intentional heterogeneity in autologous cell-based gene therapies" (2025) https://pubmed.ncbi.nlm.nih.gov/40480658/

"Gene regulation technologies for gene and cell therapy" (2025) https://pubmed.ncbi.nlm.nih.gov/40195118/

"Engineering the next generation of allogeneic CAR cells" (2025) https://pmc.ncbi.nlm.nih.gov/articles/PMC12277817/

"Emerging Strategies of Cell and Gene Therapy Targeting the Tumor-Immune Microenvironment" (2025) https://pmc.ncbi.nlm.nih.gov/articles/PMC12163603/

Additional articles for journal clubs and debate sessions will be given by the course organizers prior to the course.

Other information

Replacing H7F2444.