Cancer Biology Core Course 2026

Session 1: Introduction to Cancer Biology

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Memorial Sloan Kettering Cancer Center

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Introduction

1. Name
2. Lab
3. Current research focus
4. Future plans
5. Something interesting about you
6. Why cancer research?

Session 1: Introduction to Cancer Biology

Course overview



Memorial Sloan Kettering
Cancer Center

Course structure

In-person Classes

- Pre-visualization of recorded lectures
- Overview of concepts in class
- Journal Club session

September 2026

30% of final grade

Take-home Assignment

- Research project development
- Formulation of scientific question
- Writing & presentation of research proposal

October & November 2026

50% of final grade

Research Workshop

- Interactive session
- Experimental design
- Data interpretation to find conclusions

January 2027

20% of final grade

Classes

Session 1 – 8/26/26 | Introduction

Overview of the course. Brief overview of cancer biology as a research field and cancer as a human disease.

Session 2 – 9/2/26 | Cancer Initiation - Question: What makes a cell cancerous?

Required recorded lectures:

- Intro to Cancer Biology by Michael Overholtzer
- Oncogenes by Asmin Tulpule
- Tumor Suppressor Genes by Scott Lowe

Topics covered in class:

- Cancer as a disease;
- Cancer Hallmarks;
- Oncogenes vs Tumor suppressor genes;
- Initiation vs progression;
- Diagnosis and therapies.

Paper to discuss: Chan et al., Nature (2024) - *Titration of RAS alters senescent state and influences tumour initiation*

Session 3 – 9/9/26 | Tumor evolution & plasticity - Question: Why aren't cancer cells the same?

Required recorded lectures:

- Tumor Evolution by Tuomas Tammela
- Epigenetic Control of Oncogene Signaling by Ping Chi

Topics covered in class:

- Clonal evolution;
- Cancer heterogeneity;
- Genetic vs non-genetic mechanisms;
- Cell states & Plasticity;
- Selection; Therapies as selective pressure;

Paper to discuss: Chan et al., Nature (2026) - Critical role for a high-plasticity cell state in lung cancer.

Classes

Session 4 – 9/23/26 | TME & Metastasis - Question: What determines the fate of a tumor cell?

Required recorded lectures:

- Tumor Microenvironment by Mara Sherman
- Metastasis by Joan Massagué

Topics covered in class:

- Metastatic cascade; Seed & soil;
- Metastasis initiating cells; Metastatic niche;
- Immune surveillance;
- Dormancy & Reawakening;
- Late recurrence; Organotropism.

Paper to discuss: Chia et al., Nature (2025) - Respiratory viral infections awaken metastatic breast cancer cells in lungs

Session 5 – 9/30/26 | Precision oncology - Question: How do we turn cancer biology into treatment?

Required recorded lectures:

- Precision Medicine by Charles Rudin
- Myeloid Malignancies by Ross Levine

Topics covered in class:

- Actionable oncogenic drivers;
- Biomarkers;
- Traditional therapies;
- Targeted therapies;
- Immuno-therapies;
- Response & Acquired Resistance;
- Limitations of precision oncology;

Paper to discuss: Cercek et al., NEJM (2025) - Nonoperative Management of Mismatch Repair–Deficient Tumors

Journal club – what are we trying to learn?

Think like a scientist, not just a reader
The goal is NOT to memorize what the authors concluded.

For every paper, ask:

WHY?
What is the scientific question? Why did they do this study?

HOW?
How did they design the experiments to answer that question?

WHAT?
What do the data actually show?

SO WHAT?
Do the data support the authors' conclusions? Why does it matter?

WHAT NEXT?
What is missing? What would you do next?

Journal club – come ready to discuss any figure

Groups will be called randomly to explain each figure.
Everyone should be prepared to discuss the entire paper. For every figure, be ready to explain:

1 - QUESTION
What question are the experiments addressing?

2 - EXPERIMENTS
What did they do? What are the controls?

3 - RESULTS
What do the data actually show?

4 - CONCLUSION
What do the authors conclude? **Do you agree?**

5 - CRITIQUE
Are controls or experimental conditions missing?
Are there alternative interpretations?
Would you have done anything differently?
What are the limitations?

6 - NEXT STEP
What experiment would you do next?

The simplest formula to remember:
QUESTION → EXPERIMENT → RESULT → CONCLUSION → CRITIQUE → NEXT STEP

Course Evaluation

1. Class Participation and Attendance (30%): All scholars are expected to attend all sessions and actively participate in discussions. A scholar must notify the instructor and program team by email prior to class if they will be absent.

2. Take-Home Group Project (50%): Evaluation will consider the scientific rationale, formulation of the research question, experimental design, critical thinking and interpretation, scientific writing, clarity of the final presentation, and ability to answer questions.

3. Performance in Research Project Workshop (20%): All scholars are expected to attend the Research Project Workshop and despite working in groups, each person will be expected to present and discuss the rationale of the group's decisions.

Take-Home Assignment:
Design Your Own Cancer Research Project

Your challenge
Working in small groups, identify an **unanswered biological question in cancer research** and develop a research proposal to address it. Your proposal should take us from:

KNOWLEDGE GAP → QUESTION → HYPOTHESIS → EXPERIMENTS → EXPECTED RESULTS → IMPACT

Written Research Proposal (Max. 3 pages)

- Abstract: What are you proposing and why?
- Background & Significance: What do we know? What don't we know? Why does it matter?
- Central Question & Hypothesis
- 2 to 3 Specific Aims
- Experimental Approach
  - Experimental design
  - Models and key methods
  - Appropriate controls
  - Expected results & interpretation
- Potential Problems & Alternative Approaches
- Impact & Future Directions
- References *(not included in the 3-page limit)*

Take-Home Assignment:

Design Your Own Cancer Research Project

1 - IDENTIFY A QUESTION
Choose an important, unanswered question in cancer biology.
↓
2 - DEVELOP YOUR PROPOSAL
Design experiments that can answer your question and test your hypothesis.
↓
3 - SUBMIT
Submit a **3-page research proposal**.
↓
4 - FEEDBACK
I will review your proposal and provide feedback on the scientific question, experimental design, and feasibility.
↓
5 - REVISE
Use the feedback to strengthen your project.
↓
6 - PRESENT
Present your final research proposal to the class.

The goal is not to design a "perfect" project, it is to demonstrate how you think as a scientist.

Research Project Workshop

You are the scientist. What would you do next?

OBSERVE
What do the data tell you?
↓
QUESTION
What biological question(s) do they raise?
↓
HYPOTHESIZE
What could explain your observation?
↓
DESIGN
What experiment would you perform next?
↓
INTERPRET
What do the new data tell you?
↓
REPEAT!

You decide where the project goes.
Different groups may ask different questions, test different hypotheses, and follow **completely different experimental paths. There is no single "correct" path**

Research Project Workshop

You are the scientist. What would you do next?

You have 2 hours to build your scientific story!

For every step, your group should consider:
QUESTION - What are we trying to understand?
HYPOTHESIS - What do we think is happening?
EXPERIMENT - How can we test it? What controls do we need?
PREDICTION - What would different outcomes mean?
DATA - Request the experiment and receive the available results
INTERPRETATION - What can we conclude? What *can't* we conclude?
NEXT STEP - Where do we go from here?

A few rules:

- No internet or literature searches
- You can ask me about methods or technical concepts
- Not every experiment you request will have available data
- Negative or unexpected results are still results!

At the end, each group will briefly present:
Experimental journey → Key findings → Final model/conclusion → Next experiment

Any questions?

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