60. Developmental Oncology: Pathways, Mechanisms, and Therapeutic Insights
1 unit, **Urmila Sehrawat, November 25, 2025**

Background and Rationale

Cancer development is closely connected to the mechanisms that regulate embryogenesis and tissue regeneration. Key developmental pathways—such as Hedgehog, Wnt/β-catenin, Notch, and MYC—are often exploited in cancer to enhance cell growth, maintain stemness, and develop resistance to therapy. Viewing cancer as "development gone awry" offers a valuable perspective that combines molecular biology, developmental biology, and oncology. This approach also underscores both the potential and the difficulties in translation, especially considering the danger of targeting pathways that are crucial for normal tissue function.

This lecture is designed to engage students in active learning, moving beyond passive listening to include **case-based learning, debates, and interactive quizzes**. It is structured for medical, graduate, or advanced undergraduate learners interested in cancer biology, translational medicine, or developmental biology.

Biological Concepts to Be Covered

- Core signaling pathways in development and cancer: **Hedgehog, Wnt/β-catenin, Notch, and MYC**
- Concepts of **cell of origin, lineage plasticity, EMT (**Epithelial-to-Mesenchymal Transition)**, cancer stem cells, and epigenetic reprogramming**
- Clinical applications and therapies: **differentiation therapy (e.g., ATRA in APL), pathway inhibitors, and translational limitations**

Learning Objectives

By the end of this session, participants will be able to:

1. Explain how developmental pathways are reactivated in oncogenesis.
2. Analyze the context-dependent roles of Hedgehog, Wnt, Notch, and MYC in selected cancers.
3. Evaluate the therapeutic potential and limitations of targeting developmental pathways.
4. Apply biological knowledge to real-world clinical case studies and ethical debates in oncology.

Format and Duration

- **Session Length:** 15–20 minutes
- **Format:** One interactive lecture session combining short presentations, case-based discussion, debates, and quizzes

5 mins break!

Interactive Engagement Plan

- **Case Studies (~20 min):**
  - *Medulloblastoma (Hedgehog inhibition)*
  - *Colorectal cancer (Wnt/β-catenin activation)*

- *T-cell acute lymphoblastic leukemia (Notch mutations)*
- *Burkitt lymphoma (MYC translocation)*
  Each is accompanied by 2–3 guiding questions for small-group or whole-class discussion.

5 mins break!

- **Debates (10-20 min):**
  Example motions:
  - "The risks of targeting developmental pathways outweigh the benefits."
  - "Cancer should be considered primarily a developmental disease rather than a genetic disease."

5 mins break!

- **Interactive Quiz (~15-20 min):**
  Students participate in a Kahoot or in-slide multiple-choice quiz to reinforce key concepts.

Supporting Materials

- **Student Handout:** *Developmental Oncology at a Glance* (1-page summary of pathways, therapies, and discussion prompts).
- **Pre-Class Reading:** Curated review articles (Annual Reviews, Nature Reviews, PMC) with abstracts and guiding questions.
- **Quiz Deck:** Kahoot and PowerPoint versions for in-class participation.
- **Case Study Handout:** Four real-world examples linking biology to clinical oncology, with references and discussion questions.

Expected Outcomes

- Learners will integrate developmental biology with oncology, improving their understanding of cancer mechanisms.
- Students will develop critical thinking skills through debates and case discussions.
- Active learning strategies will enhance retention and engagement compared to traditional lectures.