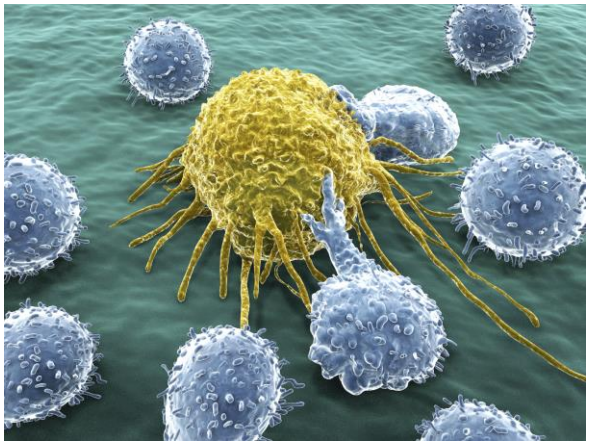
Molecular Biology of Cancer



- Cancer cells break the most basic rules of cell behavior by which multicellular organisms are built and maintained, and they exploit every kind of opportunity to do so.
- In studying these transgressions, we discover what the normal rules are and how they are enforced.
- Thus, in the context of cell biology, cancer has a unique importance, and the emphasis given to cancer research has profoundly benefited a much wider area of biomedical science than that of cancer alone.
- The body of an animal operates as a society or ecosystem.
- The individual members are cells that reproduce by cell division and organize into collaborative assemblies called tissues.
- This society is very peculiar, however, because selfsacrifice—as opposed to survival of the fittest—is the rule.

- Ultimately, all of the somatic cell lineages in animals are committed to die: they leave no progeny and instead dedicate their existence to support of the germ cells, which alone have a chance of continued survival.
- There is no particular mystery in this, for the body is a clone derived from a fertilized egg, and the genome of the somatic cells is the same as that of the germ cell lineage that gives rise to sperm or eggs.
- By their self-sacrifice for the sake of the germ cells, the somatic cells help to propagate copies of their own genes.
- Thus, unlike free-living cells such as bacteria, which compete to survive, the cells of a multicellular organism are committed to collaboration.
- To coordinate their behavior, the cells send, receive, and interpret an elaborate set of extracellular signals that serve as social controls, directing each of them how to act.

- As a result, each cell behaves in a socially responsible manner—resting, growing, dividing, differentiating, or dying—as needed for the good of the organism.
- Molecular disturbances that upset this harmony mean trouble for a multicellular society.
- In a human body with more than 10^{14} cells, billions of cells experience mutations every day, potentially disrupting the social controls.
- Most dangerously, a mutation may give one cell a selective advantage, allowing it to grow and divide more vigorously and survive more readily than its neighbors and to become a founder of a growing mutant clone.
- A mutation that promotes such selfish behavior by individual members of the cooperative can jeopardize the future of the whole enterprise.

- Over time, repeated rounds of mutation, competition, and natural selection operating within the population of somatic cells can cause matters to go from bad to worse.
- These are the basic ingredients of cancer: it is a disease in which an individual mutant clone of cells begins by prospering at the expense of its neighbors, but in the end the descendants of this clone can destroy the whole cellular society.
- Cancer cells are defined by two heritable properties: (1) they reproduce in defiance of the normal restraints on cell growth and division, and (2) they invade and colonize territories normally reserved for other cells.
- It is the combination of these properties that makes cancers particularly dangerous.
- An abnormal cell that grows (increases in mass) and proliferates (divides) out of control will give rise to a tumor, or neoplasm—literally, a new growth.

- As long as the neoplastic cells do not become invasive, however, the tumor is said to be benign, and removing or destroying the mass locally usually achieves a complete cure.
- A tumor is considered a cancer only if it is malignant, that is, only if its cells have acquired the ability to invade surrounding tissue.
- Invasiveness is an essential characteristic of cancer cells.
- It allows them to break loose, enter blood or lymphatic vessels, and form secondary tumors, called metastases, at other sites in the body.
- The more widely a cancer spreads, the harder it becomes to eradicate, and it is generally metastases that kill the cancer patient.
- Malignant tumors typically give rise to metastases, making the cancer hard to eradicate.