Cancer: Mistakes in the Cell Cycle

http://ucsdnews.ucsd.edu/pressrelease/uc_san_diego_uc_san_francisco_launch_new_cancer_cell_mapping_initiative
Checkpoint control system

- **Checkpoints**
  - cell cycle controlled by **STOP** & **GO** chemical signals at critical points (i.e. “growth factors” & “promoting factors”)
  - signals indicate if key cellular processes have been completed correctly
• Anchorage, cell density, and growth factors affect cell division

• In laboratory cultures, normal cells divide only when attached to a surface

  = anchorage dependent
• Cells continue dividing until they touch one another

= density-dependent inhibition

Figure 8.8A

Cells anchor to dish surface and divide.

When cells have formed a complete single layer, they stop dividing (density-dependent inhibition).

If some cells are scraped away, the remaining cells divide to fill the dish with a single layer and then stop (density-dependent inhibition).
• Growth factors bind to specific receptors on the plasma membrane to trigger cell division

• CANCER is different!
• Cancer cells have abnormal cell cycles
  – divide excessively and form tumors
What causes cancer?

• Cancer arises from the mutation of a normal gene.
• Mutated genes that cause cancer are called oncogenes.
• It is thought that several mutations need to occur to give rise to cancer.
• Cells that are old or not functioning properly normally self-destruct and are replaced by new cells.
• However, cancerous cells do not self-destruct and continue to divide rapidly producing millions of new cancerous cells.
How do normal cells become cancerous?

Chromosomes 1 mutation 2 mutations 3 mutations 4 mutations

Normal cell  →  →  →  → Malignant cell

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Breast cancer cell - altered morphology
Malignant tumors can invade other tissues and may kill the organism.

Figure 8.10

1. A tumor grows from a single cancer cell.
2. Cancer cells invade neighboring tissue.
3. Cancer cells spread through lymph and blood vessels to other parts of the body.

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What is the source of oncogenes?

- Mutation of a normal gene = change in DNA sequence
- UV light, Xrays, natural or synthetic chemicals
- Virus (ex. HPV and cervical cancer)
Vocabulary

• A factor which brings about a mutation is called a mutagen.

• Any agent that causes cancer is called a carcinogen and is described as carcinogenic.

• Some mutagens are carcinogenic.

• A benign tumor is a mass of abnormal cells that remains at the original site.

• A mass of these cells that invades and impairs the functions of one or more organs is called a malignant tumor.
STATISTICS U.S. 2014

- One in 4 deaths is due to cancer
- Estimated new cancer cases: 1,665,540. Estimated deaths: 585,720
- Average lifetime breast cancer risk for a woman 12.3% (1 in 8 women)

<table>
<thead>
<tr>
<th>Estimated New Cases*</th>
<th>Males</th>
<th>Females</th>
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<tbody>
<tr>
<td>Prostate</td>
<td>233,000</td>
<td>232,670</td>
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<tr>
<td>Lung &amp; bronchus</td>
<td>116,000</td>
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<tr>
<td>Colorectum</td>
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<td>Oral cavity &amp; pharynx</td>
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<td>All Sites</td>
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<th>Estimated Deaths</th>
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<tr>
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<td>All Sites</td>
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<td>275,710</td>
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Detecting Cancer

- The earlier the diagnosis the better the prospect for survival
- Magnetic resonance imaging (MRI)
- Computerized axial tomography scan (CAT scan)
- Prostatic ultrasound
- Regular self-exams, and check ups
New Hope In Cancer Treatments!

- Remove less surrounding tissue during surgery
- Combine surgery with radiation or chemotherapy
- Immunotherapy
- Cancer-fighting vaccines
- Gene therapy
- Stem cell research