Cancer 1

- iClicker 30A
- Cancer
  - Mechanisms (intro)
  - Cell Division I
- iClicker 30B

- Due in Lab this week
  - Lab report #9
  - Pre-lab #10

- Register your iClicker!

Cancer

**for Bio III, cancer is uncontrolled cell division (mitosis)**

in medical field: malignant tumors = cancer  
benign tumors ≠ cancer  

**cell growth is controlled by growth factors (GF)**

GF: produced by other cells and stimulate target cell to divide
cells to divide
(ex. healing, growth, etc.)

- cells do not divide unless told to

ex. erythropoietin ("epo") = small protein growth factor
produced by kidneys when the # of red blood cells is too low

- epo stimulates red blood cell producing cells to divide rapidly and create more red blood cells

Pathology of Cancer

normal cells

normal cells loses growth control uncontrolled cell division

tumor mass 

benign malignant
detaches and migrates to a new location

Cancer cells can spread to other organs via blood or lymphatic system 

metastasis 

other organs

How does cancer kill?

as a tumor grows and spreads, it squeezes or destroys blood vessels, nerves, vital organs, etc. until the organ can no longer do its job → death

cancer accounts for ~ 28% of all US deaths

ex. lung cancer → a cell in your lungs loses growth control and produces a tumor

~ 19% of all US cancers

~ 34% of US cancer deaths
Bio 111 Lung Cancer Statistics

**Major types:** (distinguished by where they form & what the tumor cells look like)
- Epidermoid carcinoma
- Adeno-carcinoma
- Large Cell Carcinoma
- Small Cell Carcinoma

The following data are from Cancer: Principles & Practice of Oncology DeVita, & al.
- They are from 1985, but little has changed since then (the 2001 average 5-year survival is only 15%).

<table>
<thead>
<tr>
<th>% of cases in Smokers</th>
<th>Epidermoid Carcinoma</th>
<th>Adeno-carcinoma</th>
<th>Large Cell Carcinoma</th>
<th>Small Cell Carcinoma</th>
</tr>
</thead>
<tbody>
<tr>
<td>36</td>
<td>23</td>
<td>16</td>
<td>23</td>
<td></td>
</tr>
</tbody>
</table>

**5-year survival with treatment**

<table>
<thead>
<tr>
<th>% of all cases surviving</th>
<th>25</th>
<th>12</th>
<th>13</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>% survival after surgery</td>
<td>37</td>
<td>27</td>
<td>27</td>
<td>0</td>
</tr>
</tbody>
</table>

**Top 5 metastatic sites**

<table>
<thead>
<tr>
<th>lymph nodes</th>
<th>lymph nodes</th>
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</tr>
</thead>
<tbody>
<tr>
<td>thorax</td>
<td>pleura</td>
<td>adrenals</td>
<td>liver</td>
</tr>
<tr>
<td>pleura</td>
<td>other lung</td>
<td>adrenals</td>
<td>CNS</td>
</tr>
<tr>
<td>liver</td>
<td>adrenals</td>
<td>pancreas</td>
<td>bone</td>
</tr>
</tbody>
</table>

pleura - the membrane lining the lungs
adrenals - glands that secrete adrenaline (among other hormones)
CNS - central nervous system (brain & spinal cord)
pancreas - gland that secretes digestive enzymes & insulin

* Why so poor a prognosis?
- Lung cancer is vigorous & highly metastatic
- By the time it’s detected, the tumor has been growing for a long time.
  Typical symptoms that brought people to a doctor who then found out that they had lung cancer:

  Cancer 1-3

Lung cancer is 10x higher in smokers
90% of people with lung cancer smoke
- persistent cough
- hemoptysis - coughing or spitting blood
- dyspnea - difficulty breathing, shortness of breath
  these would not appear until the tumor is well-developed
  - making successful treatment less likely

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**Growth Control in Cells**
- **normal** cells only divide when told to
  growth factors made by other cells

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<table>
<thead>
<tr>
<th>cell</th>
<th>receptors (proteins) for different GF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- different on different cell types</td>
</tr>
<tr>
<td></td>
<td>receptors bind GF through specific interactions</td>
</tr>
<tr>
<td></td>
<td>- H-bond, ionic bonds, phobic interactions</td>
</tr>
</tbody>
</table>
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if right combination of GF are present → bind to receptors

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2) receptors send chemical messages to genes in nucleus
3) in nucleus, specific genes are activated → transcription → translation → protein is made
4) these new proteins are the machinery for cell division
5) cell divides

2 types of chemical "messages"
1) oncogenes — "gas pedal", when active they stimulate cell division, when inactive they do nothing
2) anti-oncogenes/ tumor-suppressor genes — "brakes", when active they inhibit cell division, when inactive they do nothing

how do cells lose growth control?

- somatic mutations in genes encoding proteins that control growth and cell division
  these mutations are not inherited, they occur during development and life

you can inherit faulty genes for DNA replication → can lead to mistakes during replication