What Is Cancer?

What causes cancer?

What is the link between genes and cancer?

How is cancer diagnosed?

Can cancer be prevented?
Different Kinds of Cancer

Some common carcinomas:
- Lung
- Breast (women)
- Colon
- Bladder
- Prostate (men)

Leukemias:
- Bloodstream

Lymphomas:
- Lymph nodes

Some common sarcomas:
- Fat
- Bone
- Muscle

Illustration by Jeannie Kelly, © 2004

National Cancer Institute
Naming Cancers

Cancer Prefixes Point to Location

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>adeno-</td>
<td>gland</td>
</tr>
<tr>
<td>chondro-</td>
<td>cartilage</td>
</tr>
<tr>
<td>erythro-</td>
<td>red blood cell</td>
</tr>
<tr>
<td>hemangio-</td>
<td>blood vessels</td>
</tr>
<tr>
<td>hepato-</td>
<td>liver</td>
</tr>
<tr>
<td>lipo-</td>
<td>fat</td>
</tr>
<tr>
<td>lympho-</td>
<td>lymphocyte</td>
</tr>
<tr>
<td>melan-</td>
<td>pigment cell</td>
</tr>
<tr>
<td>myelo-</td>
<td>bone marrow</td>
</tr>
<tr>
<td>myo-</td>
<td>muscle</td>
</tr>
<tr>
<td>osteo-</td>
<td>bone</td>
</tr>
</tbody>
</table>
Loss of Normal Growth Control

Normal cell division

Cell damage—no repair

Cell Suicide or Apoptosis

Cancer cell division

First mutation  Second mutation  Third mutation  Fourth or later mutation

Uncontrolled growth
Example of Normal Growth

- Dead cells shed from outer surface
- Epidermis
- Dividing cells in basal layer
- Dermis
- Cell migration
The Beginning of Cancerous Growth
Invasion and Metastasis

1. Cancer cells invade surrounding tissues and blood vessels.
2. Cancer cells are transported by the circulatory system to distant sites.
3. Cancer cells reinvade and grow at new location.
Malignant versus Benign Tumors

Benign (not cancer) tumor cells grow only locally and cannot spread by invasion or metastasis.

Malignant (cancer) cells invade neighboring tissues, enter blood vessels, and metastasize to different sites.
Why Cancer Is Potentially Dangerous

- Brain
- Liver
- Melanoma (initial tumor)

Melanoma cells travel through bloodstream
Go to http://www.hhmi.org/biointeractive/, then at the top of the screen under the Topic tab, choose cancer with the drop down menu at the top, and then scroll down to:

Research Mechanics: Putting the Brakes on Cancer, Lecture.

In the first part (segments 1 – 13) – The nature of cancer is explained. Examples of various benign, malignant, and metastatic tumors are shown. An animation of angiogenesis shows tumor cells multiplying, recruiting blood vessels, and metastasizing. (22 minutes, 25 seconds)

In the second part (segments 18-31), cancer is defined as a genetic disease. The three types of genes that mutate to cause cancer – oncogenes, tumor suppressor genes, and repair genes. One example of cancer is familial colon cancer and there are two main kinds – FAP (polyposis) caused by a tumor suppressor gene mutation and HNPCC (non-polyposis) caused by a mismatch repair gene mutation. Also shown is the p53 tumor suppressor protein mutation which occurs in many types of cancer and environmental factors that may cause this mutation. (25 minutes)
Early Cancer May Not Have Any Symptoms
Cervical Cancer Screening

Normal Pap smear

Abnormal Pap smear

Artwork by Joanne Kelly © 2004

NATIONAL CANCER INSTITUTE
Prostate and Ovarian Cancer Screening
Colon Cancer Screening

FOBT Screening Kit
FROM

FOBT 1
FOBT 2
FOBT 3

National Cancer Institute
Go to http://www.hhmi.org/biointeractive/, then at the top of the screen under the Topic tab, choose cancer with the drop down menu at the top, and scroll down to:

Chaos to Cure: Bringing Basic Research to Patients, Lecture.

The first part (segments 1 - 13) is about colon cancer caused by a mutation of the APC gene leading to Familial Adenomatous Polyposis (FAP) Early screening saves lives. (22 minutes, 20 seconds).
Biopsy

Patient's tissue sample or blood sample

Pathology

Proteomic profile

Genomic profile
<table>
<thead>
<tr>
<th>Normal</th>
<th>Cancer</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Normal Cells" /></td>
<td><img src="image2" alt="Cancer Cells" /></td>
</tr>
<tr>
<td><img src="image3" alt="Normal Mitosis" /></td>
<td><img src="image4" alt="Cancer Mitosis" /></td>
</tr>
<tr>
<td>Large number of irregularly shaped dividing cells</td>
<td></td>
</tr>
<tr>
<td>Large, variably shaped nuclei</td>
<td></td>
</tr>
<tr>
<td>Small cytoplasmic volume relative to nuclei</td>
<td></td>
</tr>
<tr>
<td>Variation in cell size and shape</td>
<td></td>
</tr>
<tr>
<td>Loss of normal specialized cell features</td>
<td></td>
</tr>
<tr>
<td>Disorganized arrangement of cells</td>
<td></td>
</tr>
<tr>
<td>Poorly defined tumor boundary</td>
<td></td>
</tr>
</tbody>
</table>
Hyperplasia

Normal

Hyperplasia
Normal Common Mole with Distinct Edges (Left) and Dysplastic Nevus (Right) with Irregular Edges and Color Fading into the Skin Around It

http://www.cancer.gov/cancertopics/prevention/skin/molephotos
Carcinoma in Situ

- Normal
- Hyperplasia
- Mild dysplasia
- Carcinoma in situ (severe dysplasia)
- Cancer (invasive)
Melanoma (Cancer) Lesions

http://www.cancer.gov/cancertopics/pdq/treatment/melanoma/HealthProfessional
Tumor Staging

Five-Year Survival Rates for Patients with Melanoma (by stage)

100%

50%

Stage at Time of Initial Diagnosis

I

II

III

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