

# Cancer Biology, Pathology and Genetic Predisposition


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1

## Disclosure



- I have no conflicts of interest in relation to this program or presentation.

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2

## Objectives



- Define cancer and associated terminology
- Review how cancer occurs and summarize cancer risk factors
- Recognize red flags of hereditary cancer syndromes and which patients should consider hereditary cancer genetic testing

3

## Cancer Background



- Definition
  - “Cancer is a disease in which some of the body’s cells grow uncontrollably and spread to other parts of the body”- National Cancer Institute
- Two main categories
  - Hematologic cancer
  - Solid tumor cancer
- Not a single condition, but actually 100s of different diseases

4

## Cancer Incidence



- According to the American Cancer Society, the estimated number of new cancer cases in 2023 will be ~1.9 million in the US and ~34,000 in MN
  - #1 most common- female breast cancer
  - #2 most common- prostate cancer
  - #3 most common- lung cancer
- ~41% of men and women will be diagnosed with cancer during their lifetime (based on 2017-2019 data)
- Median age of diagnosis: age 66

5

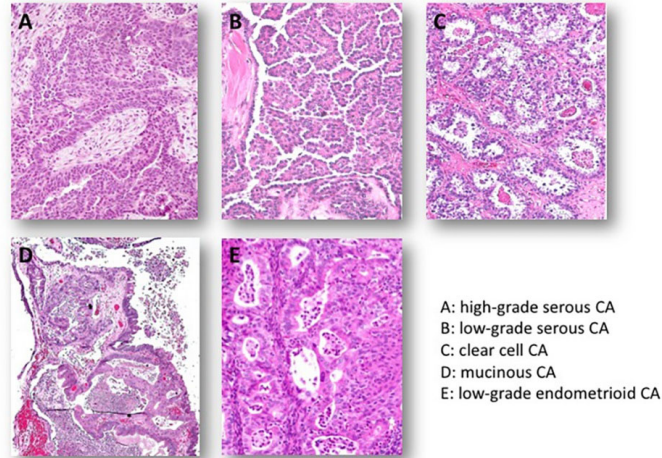
## Cancer Terminology



- Tumor: a mass of tissue that results from abnormal cell growth and division
  - Benign- not cancerous, cells don't spread to other areas of the body
  - Malignant- cancerous, cells will invade or spread to other areas of the body
- Carcinoma: cancer that begins in the skin or tissues that line internal organs
- Sarcoma: cancer that begins in the bone or connective tissue
- In situ: "in the original place", no penetration of the basement membrane

6

## Cancer Pathology

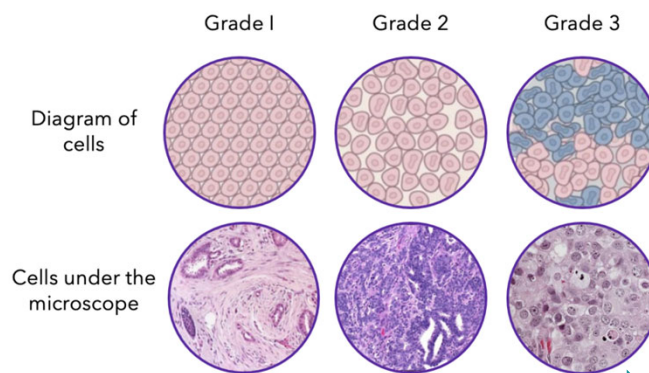


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7

7

## Cancer Grade



- Faster growing and more disorganized cells
- More aggressive tumor

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[wise.uk/pathology-report/](https://www.allinahealth.com/wise.uk/pathology-report/)

8

8

## Cancer Stage

- Stage 0 to IV
  - Stage 0: abnormal cells that haven't spread (aka in situ)
  - Stage I-III: cancer that hasn't spread beyond the site of the primary tumor or have only spread to nearby tissue
  - Stage IV: cancer has spread to distant areas of the body



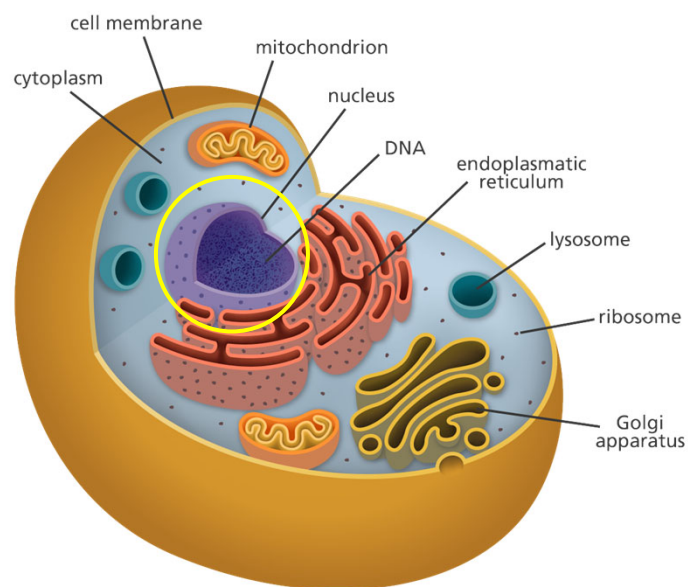
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[onhealth.com/content/1/cancer\\_types\\_treatment](https://onhealth.com/content/1/cancer_types_treatment)

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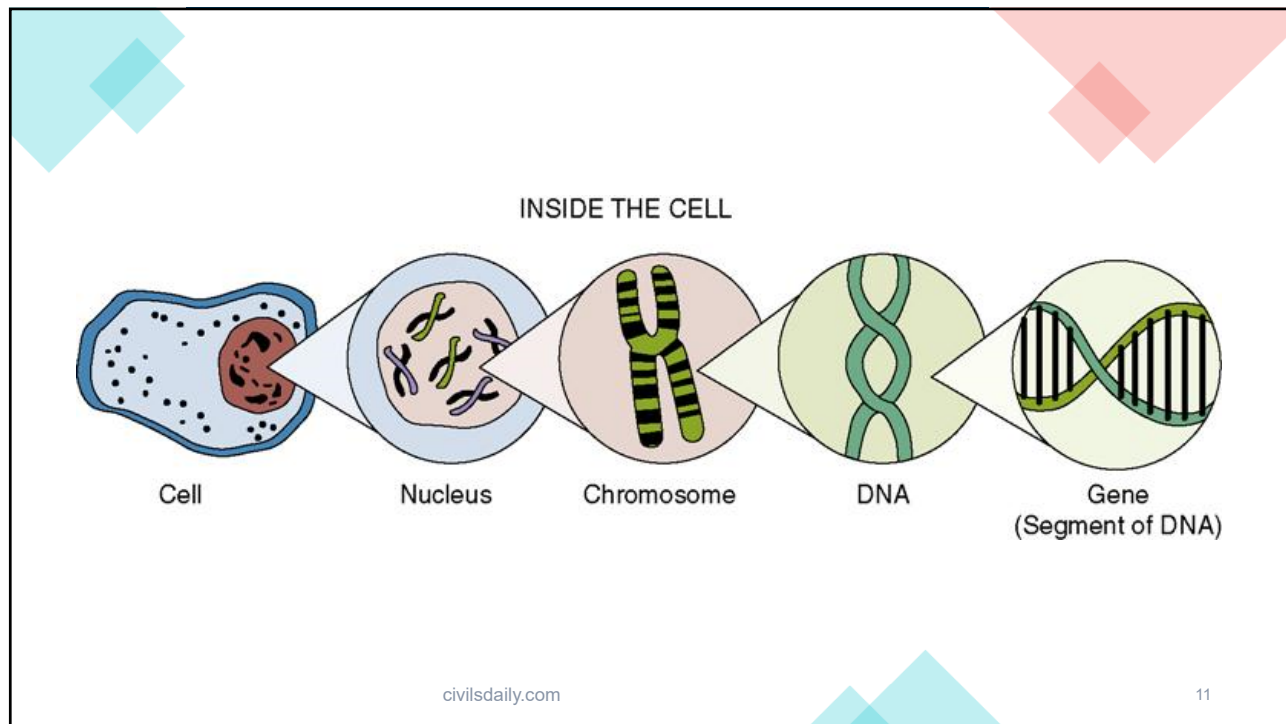
## Cell Biology Review



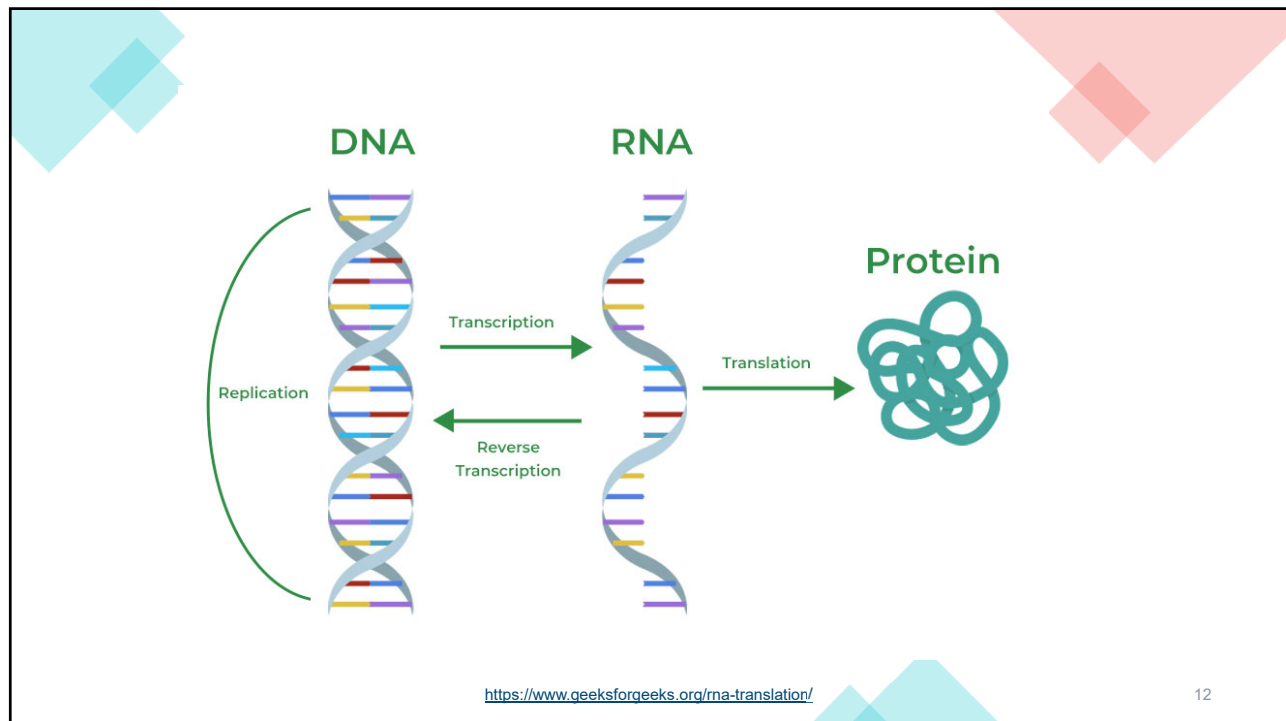
yourgenome.org

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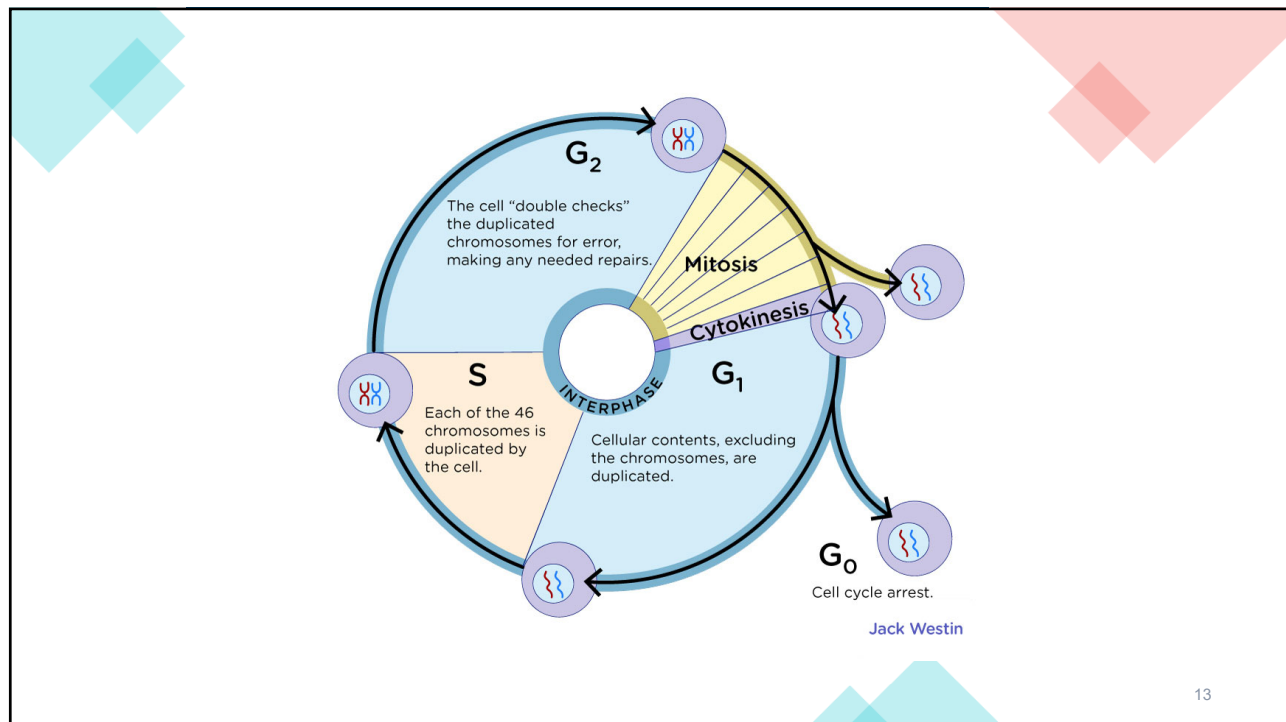
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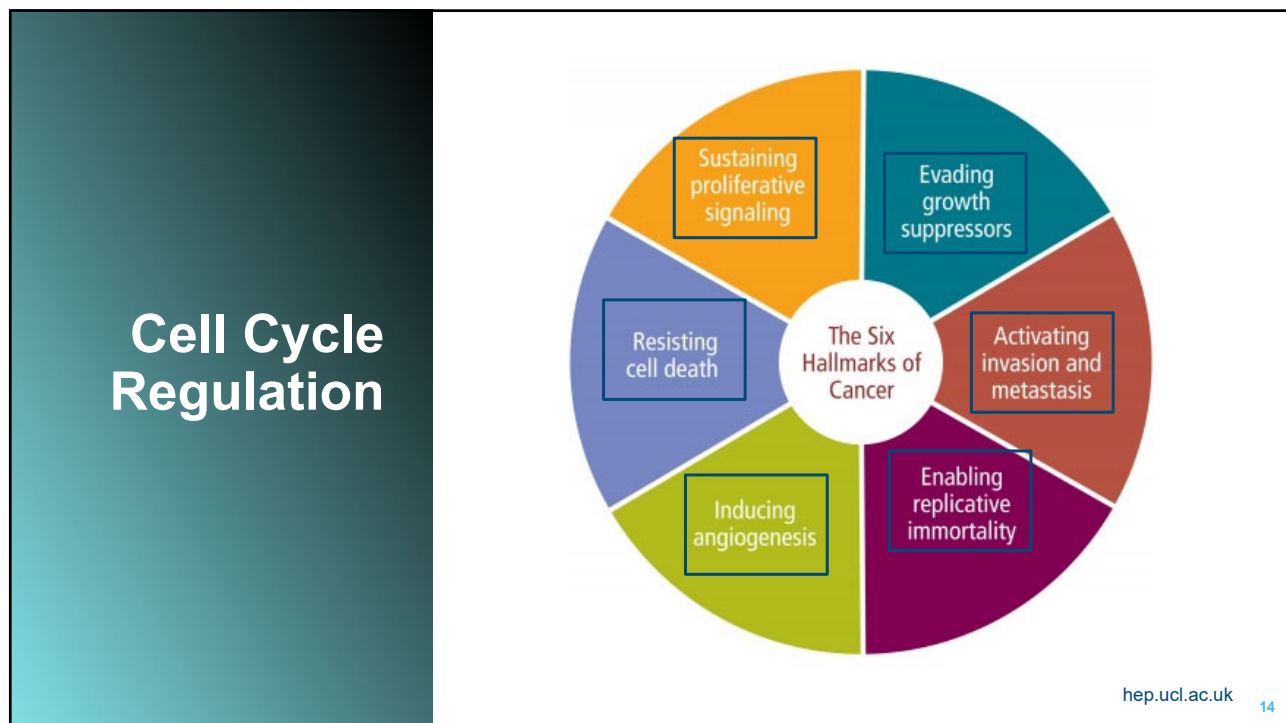
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12



13



14

## Cell Cycle Regulation

- DNA repair genes
  - Fix errors made during DNA replication
  - Inactivation leads to cancer development
  - Ex: *MLH1*, *MSH2*, *MSH6*, *PMS2*
- Tumor suppressor genes
  - Negatively regulate the growth of cells
  - Inactivation leads to cancer development
  - Ex: *BRCA1/2*
- Oncogenes
  - Play roles in cell cycle regulation
  - Activation leads to cancer development
  - Ex: *RET*

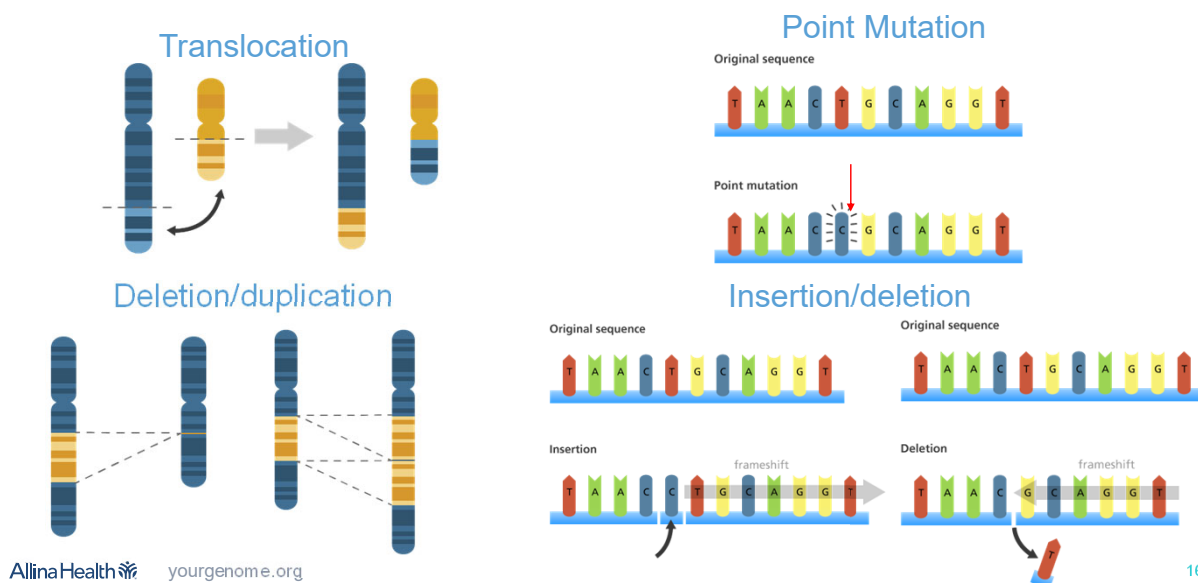
labs.wsu.edu

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15

15

## Types of Gene Mutations

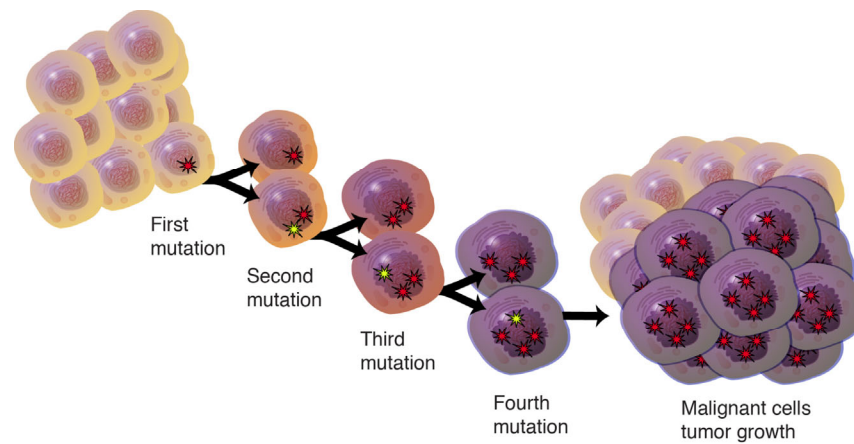


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16



## Cancer: A Genetic Disease



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dnascience.plos.org

17

17

## Cancer Risk Factors



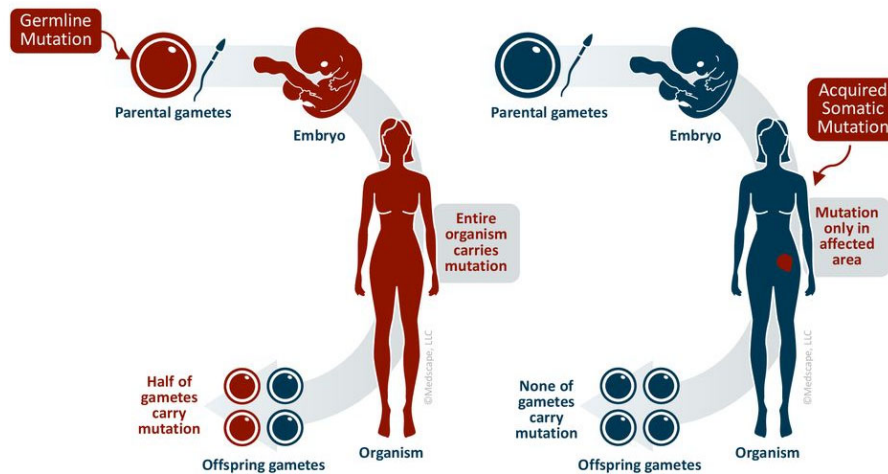
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18

## Cancer: Genetic, But Not Always Inherited



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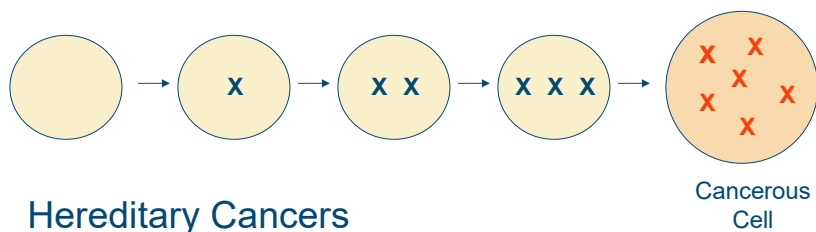
Medscape

19

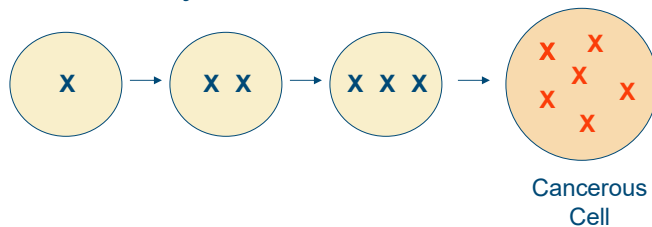
19

## Cancer: Genetic, But Not Always Inherited

### Sporadic Cancers



### Hereditary Cancers



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20

20

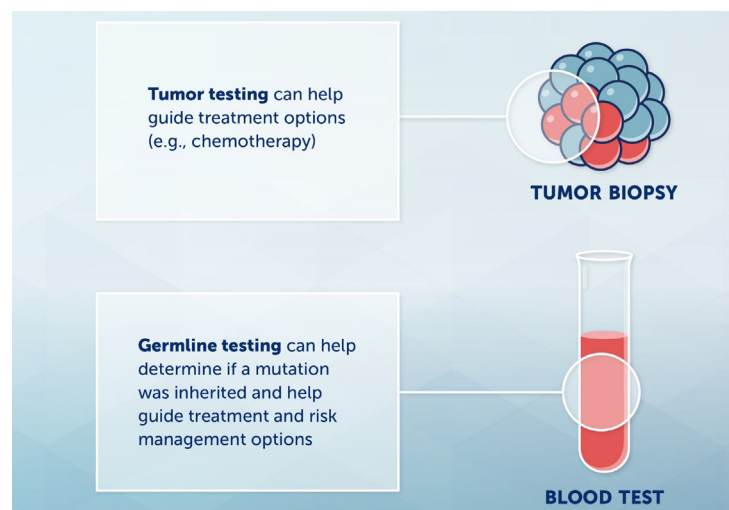
## Cancer: Genetic, But Not Always Inherited



Germline mutations	Somatic mutations
<ul style="list-style-type: none"> <li>• Occur initially in the egg or sperm</li> </ul>	<ul style="list-style-type: none"> <li>• Occur in non-germline cells (ex: breast, colon, lung, etc.)</li> </ul>
<ul style="list-style-type: none"> <li>• Are inherited</li> </ul>	<ul style="list-style-type: none"> <li>• Not inherited</li> </ul>
<ul style="list-style-type: none"> <li>• Mutation is present in all cells of the body</li> </ul>	<ul style="list-style-type: none"> <li>• Mutation is only present in some cells in the body</li> </ul>
<ul style="list-style-type: none"> <li>• ~5-10% of all cancers are hereditary</li> </ul>	<ul style="list-style-type: none"> <li>• ~90-95% of all cancers are sporadic</li> </ul>

21

## Genetic Testing



22