

Ch. 5  
**Cancer**  
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**Cancer**

- What causes Cancer?
  - Smoking
  - radiation (solar, nuclear)
  - carcinogenic chemicals
  - Hormones
  - viruses

**Causes of Cancer**

The pie chart illustrates various causes of cancer, with Tobacco and Diet being the most prominent. Other factors include Sun and Radiation, Occupation, Gender, Infection, Pesticides, Alcohol, Medication, Additives, and Food.

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**But what is cancer?**

- Cancer occurs when cell division goes out of control
- Cancer is a failure of the natural cell cycle

The diagram shows the cell cycle as a continuous loop. It starts with Interphase, which is divided into three stages: G<sub>1</sub>, S, and G<sub>2</sub>. In G<sub>1</sub>, the cell grows and carries out normal functions. In the S phase, DNA is replicated. In G<sub>2</sub>, the cell prepares for division. Mitosis follows, consisting of Prophase, Metaphase, Anaphase, and Telophase. Finally, Cytokinesis occurs, where the cell splits into two daughter cells, each with its own DNA.

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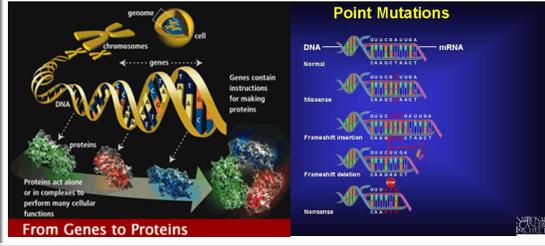
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## What makes the cell cycle fail?

- Cancers start with a MUTATION of DNA
- This causes a MUTATION in a GENE
- A GENE is the genetic directions for making a PROTEIN




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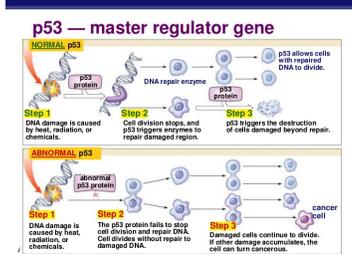
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## Mutated Gene → Mutant Protein

•The resulting mutated protein causes a failure in the natural cell cycle, causing the cells to divide uncontrollably.




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## Cancer Is a Genetic Disorder

- **Mutation:** change in genetic makeup that, in this case, causes cells to become cancerous
- **Carcinogens:** substances that increase rate of mutations and cancer risk
- **Malignant:** Tumor has invaded surrounding tissues
- **Metastasis:** Process in which cells are invasive and move to other sites in the body
- Not all tumors are cancerous, **benign** tumors, increase in size, but do not metastasize

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### Cancer Treatments

- Historical treatments: remove / kill the cancer
  - Surgery
  - Radiation
  - Chemotherapy
- New treatments: disrupt the process by which cancer cells multiply
  - = "Targeted Therapies"

**5 STANDARD**  
treatment options:

**LOCAL**                      **SYSTEMIC**

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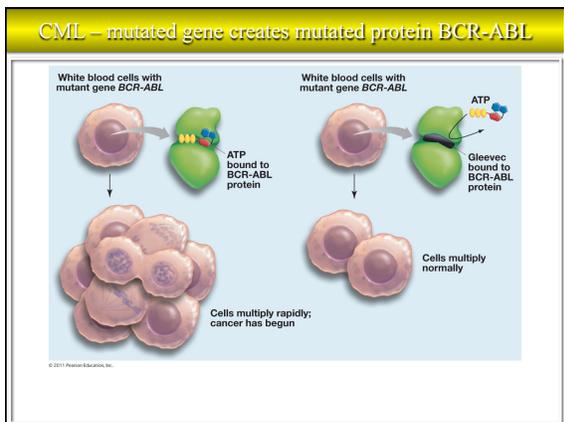
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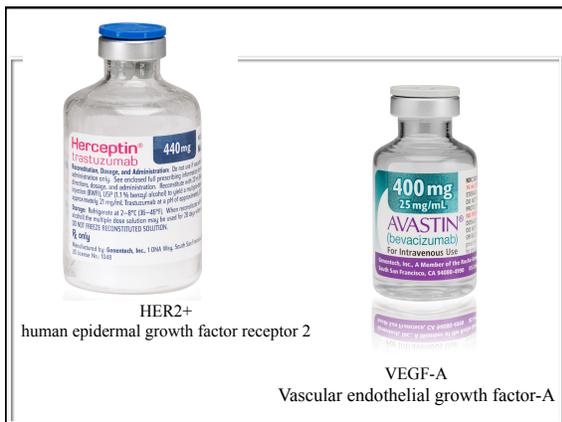
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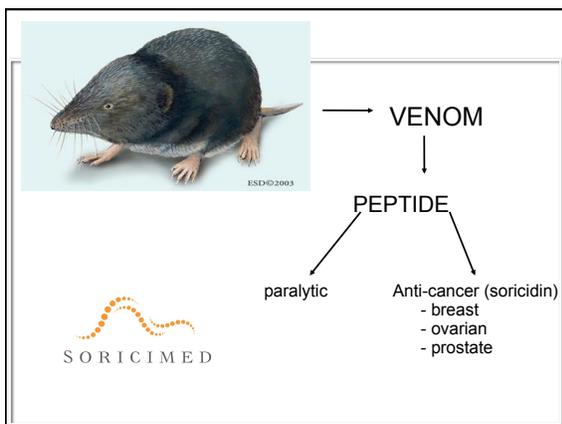
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### Anti-cancer Effect:

- Soricidin
  - Disrupts a protein found in high numbers in cancer cells that is NOT found in high amounts in normal cells
  - This protein forms a calcium ION CHANNEL on the plasma membrane
  - Inactivating this ion channel protein causes cancer cells to self-destruct

NORMAL EVENTS

Impulse propagates

EFFECTS OF SORICIDIN

Impulse cannot propagate

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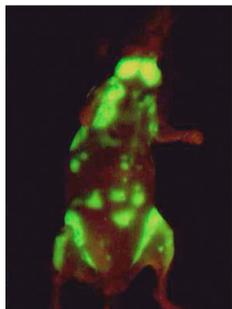
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## Shrew Protein:

- Not only can be used to kill the cancer cells, but also identify them at cancer stage 1
  - Attach a marker to the protein
    - see if the marker binds to the cell. If yes – the protein must be bound to the calcium ion channel protein – cell must be cancerous.




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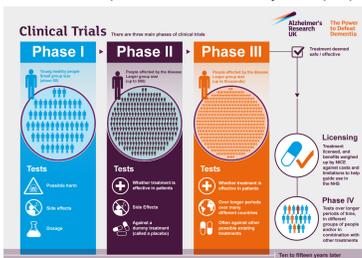
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## Now in human trials

- Stage 1 clinical trials: test drug's SAFETY
- Stage 2 clinical trials: test drug's EFFICACY
- Stage 3 clinical trials: repeat of above with many more people




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## Cancer Research in the News #1

- AVASTIN
- Targeted therapy for bowel cancer
- In advanced bowel cancer, Avastin only helps 10% - 15% of patients. Some medical insurance companies have dropped Avastin accordingly.
- Why does it not help more people?




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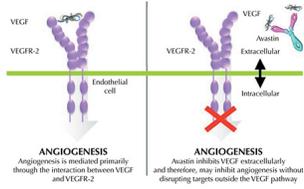
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### Avastin targets a growth factor protein

- This protein exists in TWO major forms
  - One form of the protein ENHANCES tumor growth
  - The other form SUPPRESSES tumor growth
- Avastin interrupts BOTH forms of the protein



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### What to do?

- Test cancer cells to see if patients have more of the growth enhancer protein, or more of the growth suppressor protein.
- Only prescribe Avastin if the patient has more of the growth enhancer protein.

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### Cancer in the News #2

- Fasting might improve chemotherapy
- Chemotherapy uses toxic chemicals to kill cancer cells
- Also can kill healthy cells



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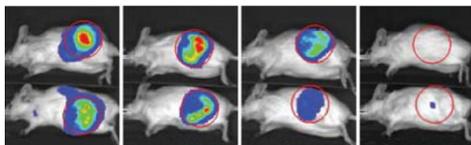
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## What did fasting do?

- Study with mice:
  - Fasted for 2 days prior to chemotherapy
  - Tumors in fasting mice shrank more
  - Fewer healthy cells destroyed




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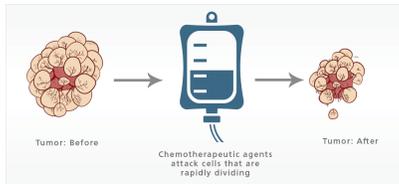
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## Why??

- Fasting made healthy cells reroute energy from growing and dividing to internal maintenance only
- Cancer cells continued to divide and multiply
- Chemotherapy preferentially attacks cells that are in the process of dividing




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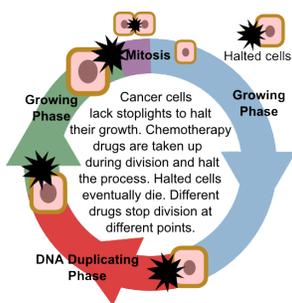
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## SUMMARY:

- Cancer is a failure of the cell cycle
- Cancer is caused by genetic mutations creating a mutated protein
- New therapies are targeted therapies
- Advances are being made daily in cancer research. Breakthroughs can come from unlikely sources.




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