

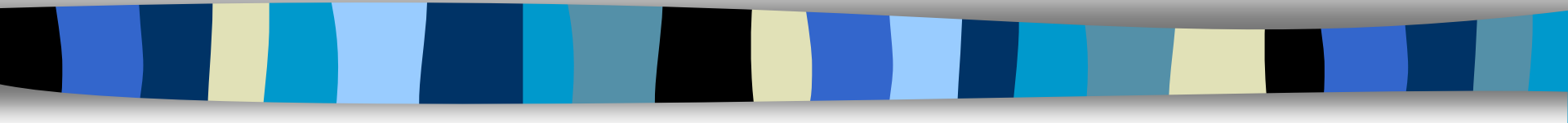


A.P. Biology

Mr. Tesoro

- Homework Reminder:
- Do Now: Why are cancer cells so dangerous?

Aim: What are the characteristics of cancer cells?





Cholesterol and Cancer – This Week in Science Magazine

Obesity and high cholesterol levels are associated with an increased risk of breast cancer in post-menopausal women. **Nelson et al. (p 1094)** found that a specific metabolite of cholesterol, 27-hydroxycholesterol (27HC), promoted tumor growth and metastasis in mouse models of mammary cancer by serving as a partial agonist (mimic) for the estrogen receptor and the liver X receptor. The most aggressive human breast cancers were found to express the highest level of the enzyme that converts cholesterol to 27 HC, suggesting that 27HC produced within tumors (in addition to circulating 27HC) may contribute to tumorigenesis.



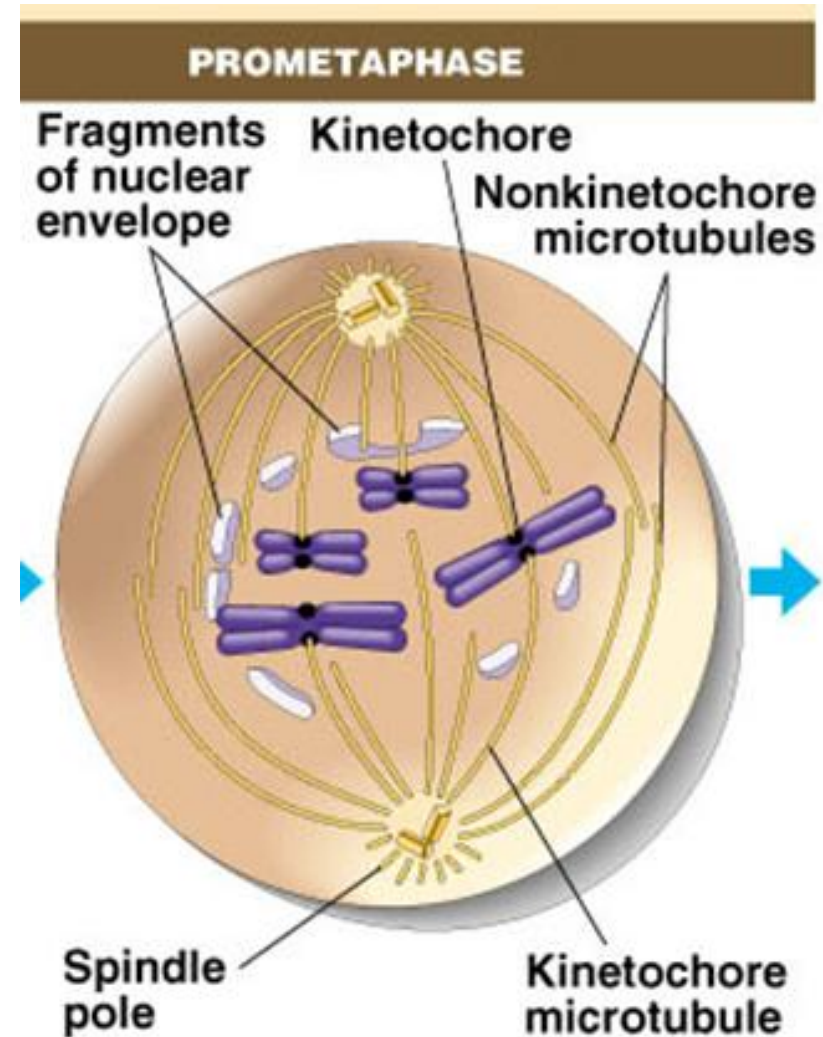
Examples of normal signaling of mitosis

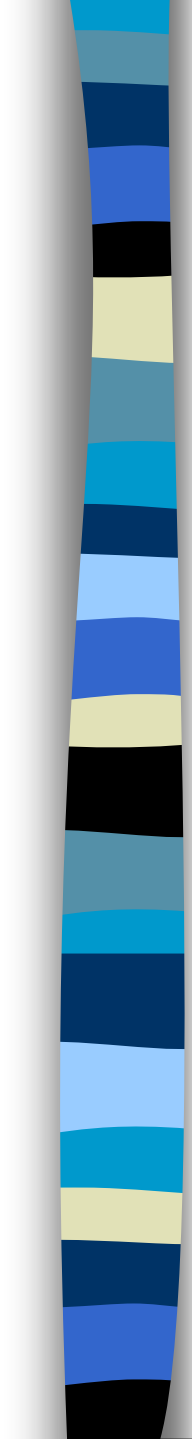
- Some mitotic signals originate inside the cell, others outside.
- 1) One mitotic checkpoint ensures that all the chromosomes are properly attached to the spindle at the metaphase plate before anaphase.
 - This ensures that daughter cells do not end up with missing or extra chromosomes.

- A signal to delay anaphase originates at kinetochores that have not yet attached to spindle microtubules.

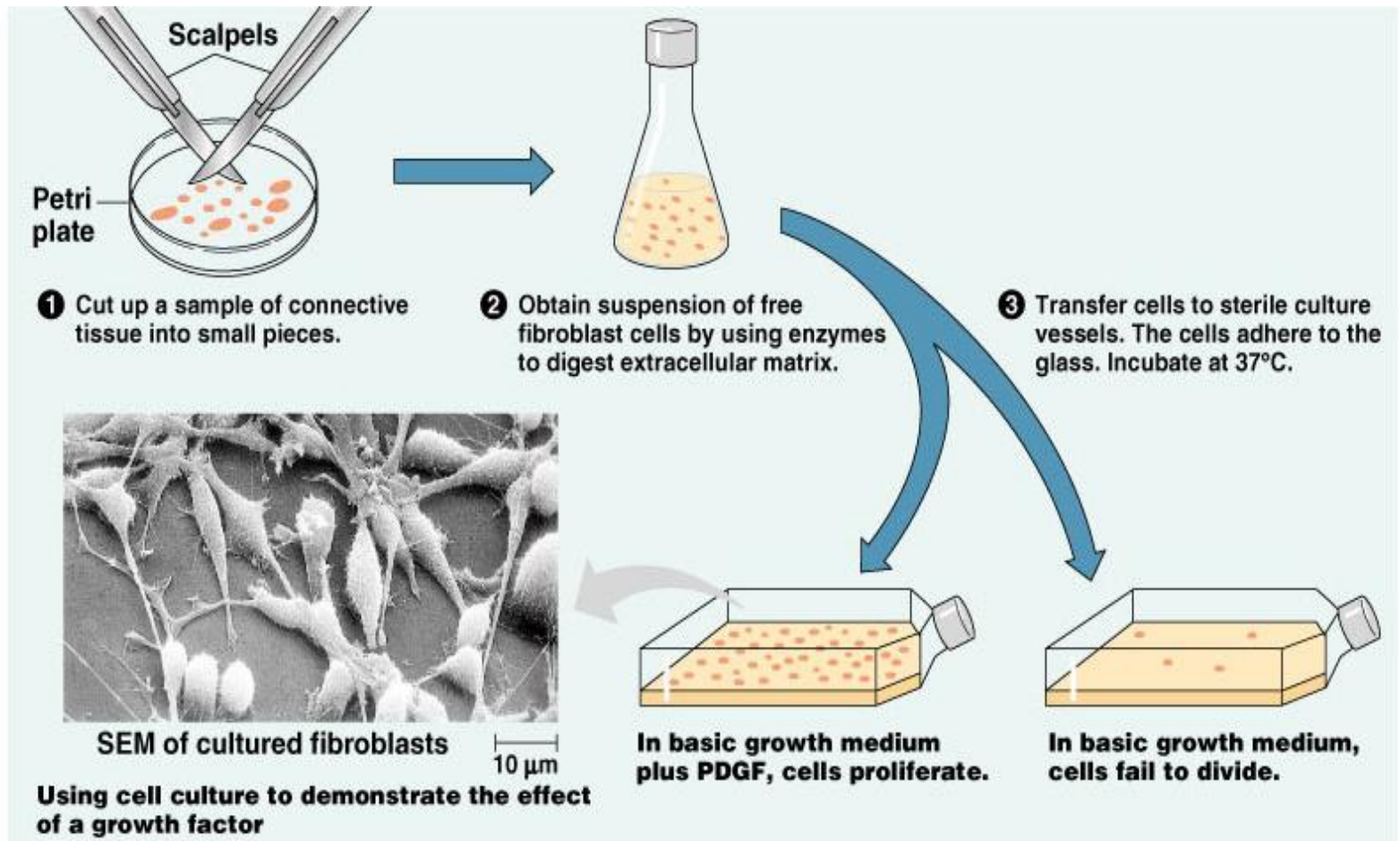
- This keeps the anaphase-promoting complex (APC) in an inactive state.

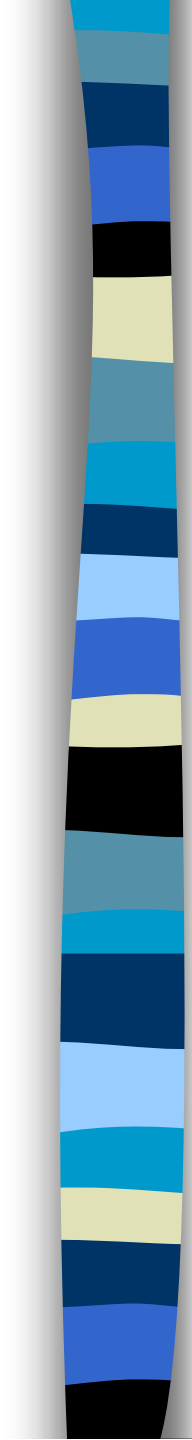
- When all kinetochores are attached, the APC activates, triggering anaphase. The chromatids now separate.



- 
- 2) A variety of external chemical and physical factors can influence cell division.
 - Particularly important for mammalian cells are **growth factors**, proteins released by one group of cells that stimulate other cells to divide.
 - For example, *platelet-derived growth factors (PDGF)*, produced by platelet blood cells, bind to receptors of fibroblasts, a type of connective tissue cell.
 - This triggers cell division.

Fibroblasts in culture will only divide in the presence of medium that also contains PDGF.



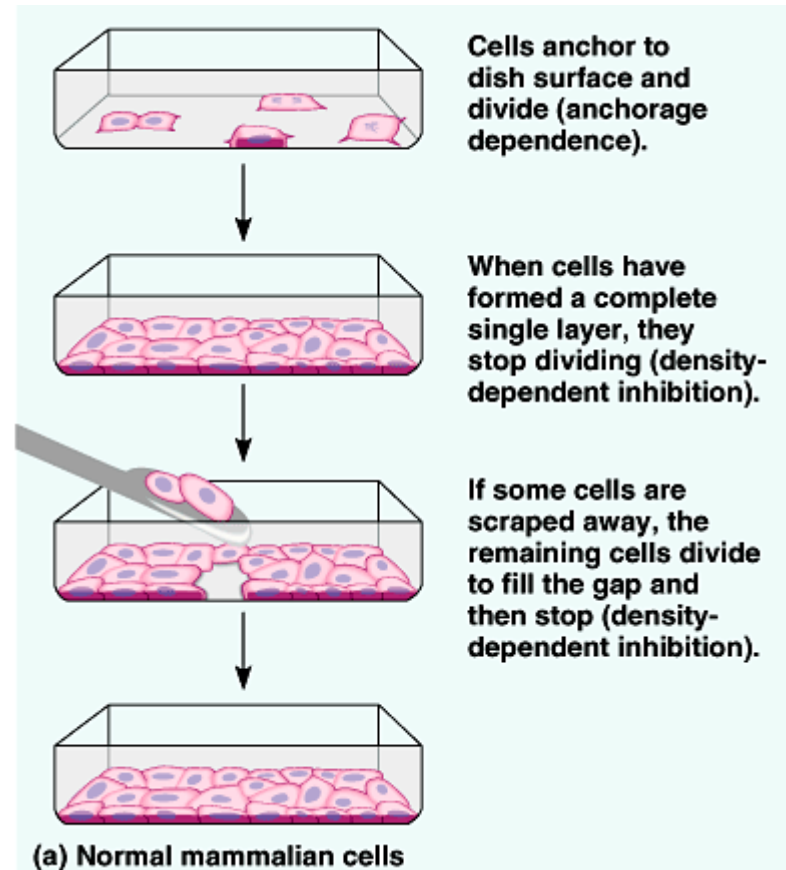
- 
- In a living organism, platelets release PDGF in the vicinity of an injury.
 - The resulting proliferation of fibroblasts help heal the wound.

- Growth factors appear to be a key in **density-dependent inhibition** of cell division.

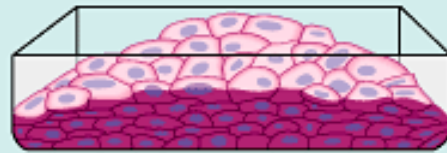
- Cultured cells normally divide until they form a single layer on the inner surface of the culture container.

- If a gap is created, the cells will grow to fill the gap.

- At high densities, the amount of growth factors and nutrients is insufficient to allow continued cell growth.



- Most animal cells also exhibit **anchorage dependence** for cell division.
 - To divide they must be anchored to a substratum, typically the extracellular matrix of a tissue.
- Cancer cells are free of both density-dependent inhibition and anchorage dependence.



(b) Cancer cells

Cancer cells do not exhibit anchorage dependence or density-dependent inhibition.



Cancer cells have escaped from cell cycle controls

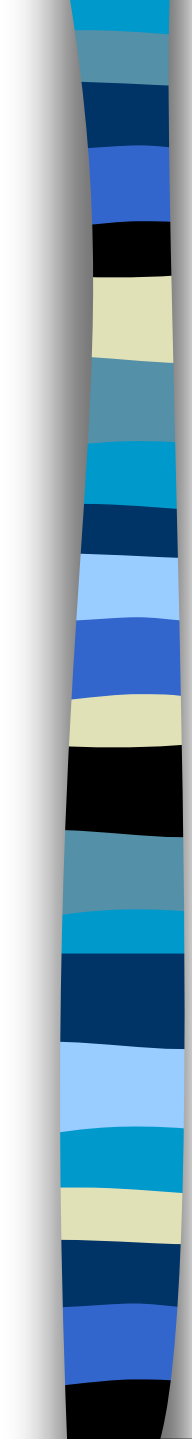
- 1) Cancer cells are free of the body's control mechanisms.
 - Usually cancer cells do not stop dividing when growth factors are depleted:
 - If cancer cells stop dividing, they do so at random points, not at the normal checkpoints in the cell cycle.

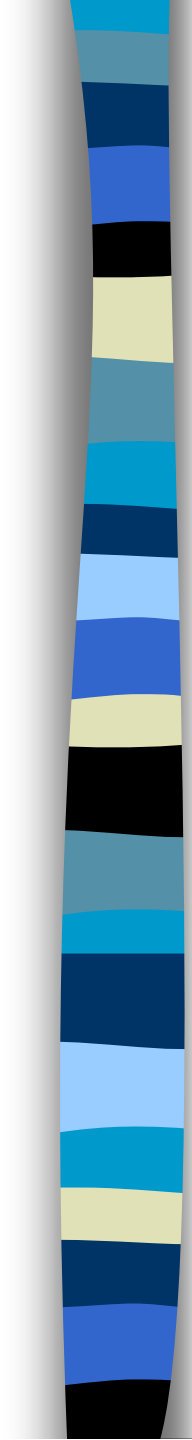
- 2) Cancer cell may divide indefinitely if they have a continual supply of nutrients.

- 3) Cancer cells may be “immortal”.

- Cells (HeLa) from a tumor removed from a woman (Henrietta Lacks) in 1951 are still reproducing in culture.



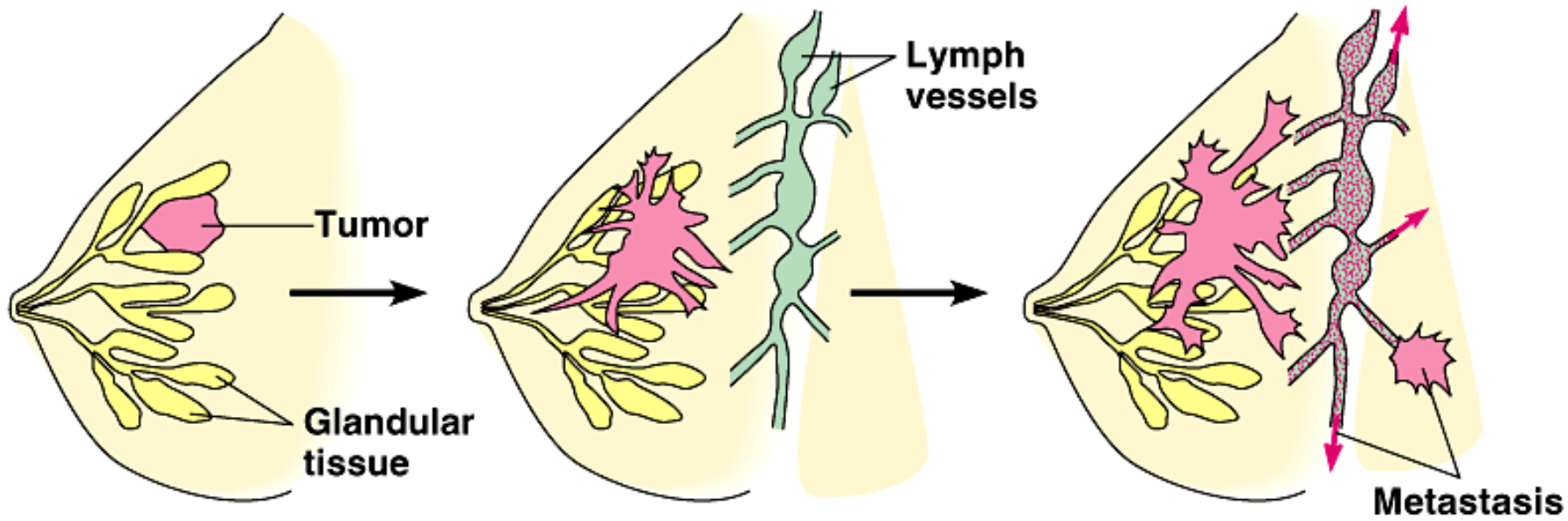
- 
- Normally, the immune system recognizes and destroys cancer cells.
 - However, cells that evade destruction proliferate to form a **tumor**, a mass of abnormal cells.
 - 4) If the abnormal cells remain at the originating site, the lump is called a **benign tumor**.
 - Most do not cause serious problems and can be removed by surgery.



•5) In a **malignant tumor**, the cells leave the original site to impair the functions of one or more organs.

- Malignant cancer cells:

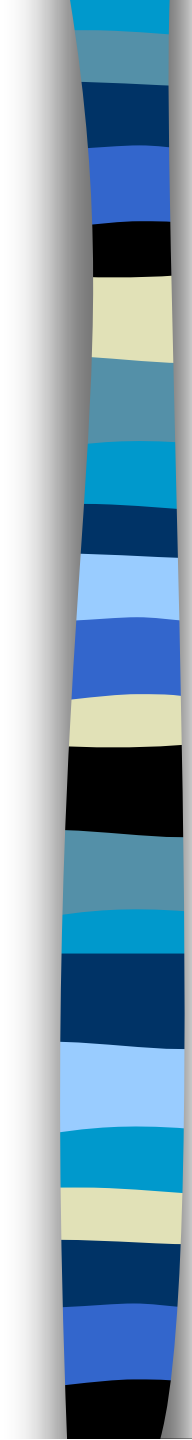
- Contain chromosomal abnormalities
- Do not behave like normal cells
- Lose attachment to other cells
- Are carrier by lymph and blood to other tissues where they start more tumors (metastatic)



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.



- 6) Treatments for metastasizing cancers include high-energy radiation and chemotherapy with toxic drugs.

- These treatments target actively dividing cells.



Characteristics of Cultured Cancer Cells

- Abnormal number of chromosomes
- Spherical and embryonic
- Anchorage independence
- Abnormal surfaces (fewer glycoproteins and glycolipids)
- Metastatic cancer cells produce laminin to bind to tissue cells and collagenase to break through and migrate.