SIGNALING AND GENETICS

VIRUSES AND SUPPRESSION

MARKERS AND TARGETING

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3 Ideas Presentation

Anonymous students MK, NM, and AW

20.020: Intro to Biological Engineering Design

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3 Ideas Presentation

- SIGNALING AND GENETICS
- VIRUSES AND SUPPRESSION
- MARKERS AND TARGETING

MISSION:

- to create an inexpensive and efficient treatment for cancer to substitute current damaging therapies such as chemotherapy and radiation

SIGNALING AND GENETICS

- CHALLENGE
- PROJECT
- QUESTIONS

VIRUSES AND SUPPRESSION

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SIGNALLING AND GENETICS

PHILOSOPHY:

- prevention before cancer reaches later stages and health is jeopardized
- stopping growth as a cure

IDEA:

- look at cellular pathways and enzymes in order to understand pathways taken by cancerous growth, and how to prevent it

SIGNALING AND GENETICS

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SIGNALLING AND GENETICS

CHALLENGE:

- IMPORTANCE:
  - to avoid use of chemotherapy
  - to find pathways similar in different types of cancer
- IMPACT:
  - keep healthy cells alive while stopping growth of cancerous cells
  - better understanding of cellular pathways

SIGNALING AND GENETICS

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SIGNALLING AND GENETICS

PROJECT:

- POSSIBLE COMPETITION:
  - similar research in area at University of California, “Glivec,” pill for treatment of leukemia, inhibitor
- KNOWNS:
  - certain pathways over-expressed during cancerous growth
  - lack of certain enzymes leads to uncontrollable replication
- UNKNOWNS:
  - which ones, how many different pathways are involved

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SIGNALLING AND GENETICS

QUESTIONS:

- BUILDABLE?
  - done before for other cell types, specific pathways used for cure
- SAFE? SECURE?
  - interrupting normal cell growth
  - effects of introducing “working” enzymes to replace lack

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PHILOSOPHY:

- to discover efficient ways to attack cancerous cells of the immune system
- to find pattern which will enable just tumor-prone cells to be targeted and suppressed/destroyed

IDEA:

- using recombinant DNA, and viruses (retrovirus and DNA), to insert sequence to cease mitotic divisions in cancer cells
- insert nonsense sequences into important regions or use lysogenic/lytic cycle to destroy the cell

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CHALLENGE:

- IMPORTANCE:
  - improve lives of those living with cancer
  - use model to target a wider range of cancers and inhibit metastasis
- IMPACT:
  - easy to program virus to change DNA of cells, easy to produce
  - could halt tumor growth early on
  - ends the possibility of metastasis which leads to further health problems in a patient

VIRUSES AND SUPPRESSION

PROJECT:

- POSSIBLE COMPETITION:
  - research in cold virus against tumor cells
- KNOWNS:
  - gene types a retrovirus needs to transform a cell to a cancerous cell
  - mechanism of cancer-causing viruses
  - link between oncogenes in viruses and oncogenes in cancerous cells
- UNKNOWNS:
  - how to make virus only attack cancer cells, the markers on cancer cells and how they may change

VIRUSES AND SUPPRESSION

QUESTIONS:

- BUILDABLE?
  - genetic recombination of this type has been done before
  - virus previously engineered to fight disease
- SAFE? SECURE?
  - how to ensure that only cancerous cells are attacked by virus
  - possibility that virus administered in-vivo could become cause of cancer in other cells, examples: “Bubble Boy Disease”

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PHILOSOPHY:

- way to attack or inhibit cancer cells without introducing foreign agents/chemicals
- combat metastasis by targeting late-stage tumor cells or cancer cells in transit

IDEA:

- identify specific markers on late-stage cancer cells and develop chemotaxis to track movements of tumors
- engineer cells from patient to target cells at source or in blood/lymph
- release chemical agents through cell-to-cell juxtacrine sensing

Image removed due to copyright restrictions.
Diagram of tumor initiation and metastasis.
Figure 1 in Chiang, A. C., and J. Massague. "Molecular Basis of Metastasis." *NEJM* 359, no. 26 (2008): 2814-2823.

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MARKERS AND TARGETING

CHALLENGE:

- IMPORTANCE:
  - to eliminate cancer cells or prevent spread without harming normal cells
  - to counteract metastasis, decisive process
- IMPACT:
  - will deter destruction of normal cell function and keep organ systems intact
  - could help deal with major cause of death due to cancer
  - if tailored with chemical markers for each cell type, could work as general inhibitor of tumor spread

MARKERS AND TARGETING

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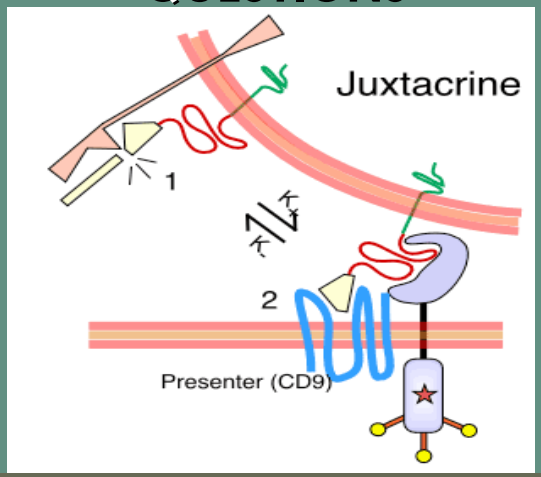

Image: US DOE / PNNL, http://www.sysbio.org/research/bsi/

PROJECT:

- POSSIBLE COMPETITION:
  - "dBaits," other "decoy" mechanisms
  - research in juxtacrine signaling can trigger non-growth in cancer cells
- KNOWNS:
  - effective chemicals for killing cancerous cells, hormones and receptors for growth
- UNKNOWNS:
  - exact markers on cancer cell types
  - if markers proliferate and at what rate, is tracking possible in human body
  - possible consequences in systems

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MARKERS AND TARGETING

QUESTIONS:

- BUILDABLE?
  - possible to build chassis from non-differentiated patient cell
  - recombination DNA to manufacture chemicals, protein receptors on membrane and chemotaxis ability
- SAFE? SECURE?
  - possible that attack cells are rejected, could compete with normal cells too
  - chemicals could reach outside of adjacent tumor cells and harm the body

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IN SUMMARY

OUR IDEAS:

- SIGNALING AND GENETICS
  - figure out cancer's cellular pathways and involved enzymes in order to understand pathways and use DNA techniques and enzymes to prevent or treat
- VIRUSES AND SUPPRESSION
  - use viruses to infiltrate cancerous cells and cause cell-death or end mitosis
- MARKERS AND TARGETING
  - develop tracking ability of tumor cells and cancer cells undergoing metastasis, use receptors for markers to find, touch sensing to trigger chemical deployment

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