**HHMI FMN – Cancer Genomics**

**Instructor Notes:**

**Uses:**

* Cell cycle introduction/review
  + High school
  + Undergraduate introductory biology course
  + Upper level biology course for review/introduction to an advanced topic such as cancer pathophysiology
* Benefits: Helps students identify the importance of the cell cycle and its relationship to cancer cell development
* How I use this activity:
  + Student population: BSN nursing students enrolled in a pathophysiology course
  + Review the cell cycle & introduce relationship of cell cycle to cancer in the genetic disease unit (genetic disease unit covers epigenetics, inherited diseases, diseases of nondisjunction, and cancer)

**Concepts and Learning Objectives:**

1. Comprehension that mutations are random changes in an organism’s DNA.
2. Identify the types of mutations that occur and the specific mutation could lead to disease.
3. Understanding that mutations can lead to the creation of a new gene or elimination of a gene.
4. Develop understanding that accumulation of mutations leads to changes in, or elimination of, gene function.
5. Explain the basic definition and process of epigenetics.  Be able to provide/explain an example discussed in class.
6. Differentiate between inherited autosomal inheritance, sex-linked inheritance, and epigenetics.
7. Using a Punnet Square, be able to identify the risk for offspring for the various patterns.
8. Explain the relationship of nondisjunction in meiosis to diseases such as Down Syndrome.
9. Understand and be able to explain the different types of genetic diseases à inheritance of an allele, issues with meiosis, and epigenetic changes (including influence of microbiome).
10. Provide examples of teratogenic agents.
11. Students identify and understand the relationship of the cell cycle to cancer.
12. Students understand the difference between oncogenes and tumor suppressor genes.
13. Introduce data analysis and basic graphing.

After completion of the activities, students should be able to apply the above listed concepts to additional assignments, class activities, and exam questions. They should be able to distinguish the difference between the different types of genetic diseases, as well as understand the pathophysiology, diagnostics, treatments, and prognosis for each disease example covered in class. This HHMI FMN project focused on the cancer genomics aspects of this 3-week course unit. Please note, I teach this as a 4-hour block to accommodate the nursing students.

**Week 1:**

* + - Students complete “THE MOLECULAR EVOLUTION OF GENE BIRTH AND DEATH” as a homework assignment: Video Clip: Birth and Death of Genes with Quiz <http://www.hhmi.org/biointeractive/making-fittest-birth-and-death-genes> and The Molecular Evolution of Gene Birth and Death Advanced Lesson: <http://www.hhmi.org/biointeractive/molecular-evolution-gene-birth-and-death>
* Handout: Genetic Mutations and Disease poster: <http://www.hhmi.org/biointeractive/genetic-mutations-and-disease>
* Covers concepts 1-4

**Week 2:**

* Collect completed worksheets from week 1.
* In-class, epigenetics, inheritance patterns, and non-disjunction diseases

**Week 3:**

* + - After grading Week 1 assignment, review any misconceptions that students encounter and review in class. Video review: Video Clip: Natural Selection in Humans <http://www.hhmi.org/biointeractive/making-fittest-natural-selection-humans>
* Mini-lecture on these topics (Powerpoint slides included):
* Proliferation vs differentiation
* Stem cells
* Protoconcogenes, oncogenes, & tumor-suppressor genes
* Complete “Cancer and the Cell Cycle” activity together in class: <http://www.hhmi.org/biointeractive/eukaryotic-cell-cycle-and-cancer> (modified worksheet included)
* Summary cancer & cycle types using this video: <http://www.hhmi.org/biointeractive/cancer-genetic-disease-video-highlights>
* Mini-lecture on these topics:
* Cancer terminology & classification
* Students watch HHMI “Learning from the Patients: The Science of Medicine”Lecture 1: Putting the Brakes on Cancer and take notes: <http://media.hhmi.org/hl/03Lect1.html?_ga=1.18733113.1054808674.1468863809>
* Students complete a course journal entry reviewing the video (completed in online learning management system).

**Week 4:**

* Begin class with discussion of video and journal entries from Week 3.
* Mini-lecture on the following topics:
* Carcinogens (compare with teratogens from week 2)
* Risk factors
* Warning signs
* Diagnostics & treatments
* Cancer nomenclature
* Complete as in-class Acitivity: Cancer Discovery Activities – Classifying Cancer Genes and Examining Patient Data
* Homework: Students read article, ““Cancer Genomic Landscapes,” and complete guided reading questions (included).