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TEACHING & LEARNING SUMMIT 2016

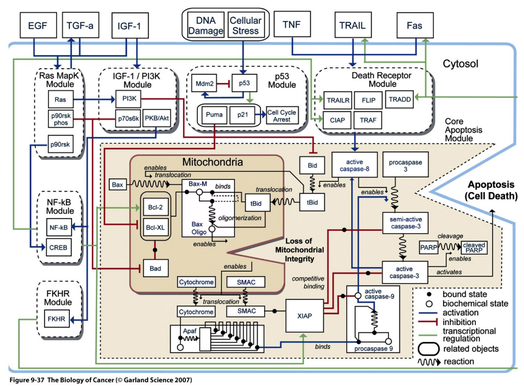


Figure 9-37 The Biology of Cancer (© Garland Science 2007)

Carnegie Mellon University

Can Flipping A Science Class Lead To Enhanced Learning, Reading and Writing

Goal: create a student-focused and student-driven active learning experience that leads to enhanced comprehension and writing in the biological sciences.

Project Design

The **objective** is to teach science students how to read, analyze, interpret, and critically assess scientific research at an advanced level. Flipping the classroom creates a more engaging, student-focused and student-driven learning experience. This approach includes: 1) self-directed learning; 2) small-group work; and 3) large-group work.

The observed **impacts** include:

1) students taking risks in their engagement of the material in meaningful ways that results in quantifiable learning;
2) in working together, students are identifying strengths and weaknesses in their own self-directed preparation;
3) students are making meaningful high-order connections in their science comprehension between lecture topics and published research.

Over the course of the semester, one can assess quantitative and qualitative improvements in student performance, comprehension, and quality of writing. Student engagement is high given the small class size and the extent of the group work. Improvement in learning is measurable because numerous reading and writing activities exist. This strategy is applicable to upper level STEM courses looking to transition away from pure lecture-based teaching.

Lessons Learned

- Self-directed learning → when students engage the material ahead of time, they formulate their baseline understanding of the science.
- Small-group work → when students discuss the science in small groups, they feel at ease to take risks in sharing their ideas, ultimately learning from several view points.
- Large-group work → when students present their knowledge in front of the larger audience, they showcase the evolution of their thought process and deeper understanding of the science.

Next Steps:

- Expand interactive sessions to allow for more discussion and analysis, by shortening and focusing individual lectures.
- Implement a rubric for grading synopses that students can use to guide their writing
- Work with the Eberly Center in collecting mid- and end-semester data on student learning in relation to active engagement and participation.
- Incorporate tutor(s) from the Global Communications Center to enhance students' abilities to write better and more concisely.
- Possibly incorporate a peer feedback component or option to do a re-write for the first two synopses.

Project Evaluation

Science Literature topics

1) Cell Signaling: EGFR Promotes Lung Tumorigenesis by Activating miR-7 through a Ras/ERK/Myc Pathway That Targets the Ets2 Transcriptional Repressor ERF
2) DNA Replication control: Chk1 promotes replication fork progression by controlling replication initiation
3) Translation: FGF2 Translationally Induced by Hypoxia Is Involved in Negative and Positive Feedback Loops with HIF-1a
4) Cancer Immunology: IL-17 Enhances Tumor Development in Carcinogen-Induced Skin Cancer
5) Cancer Genomics: Longitudinal Analysis of Androgen Deprivation of Prostate Cancer Cells Identifies Pathways to Androgen Independence

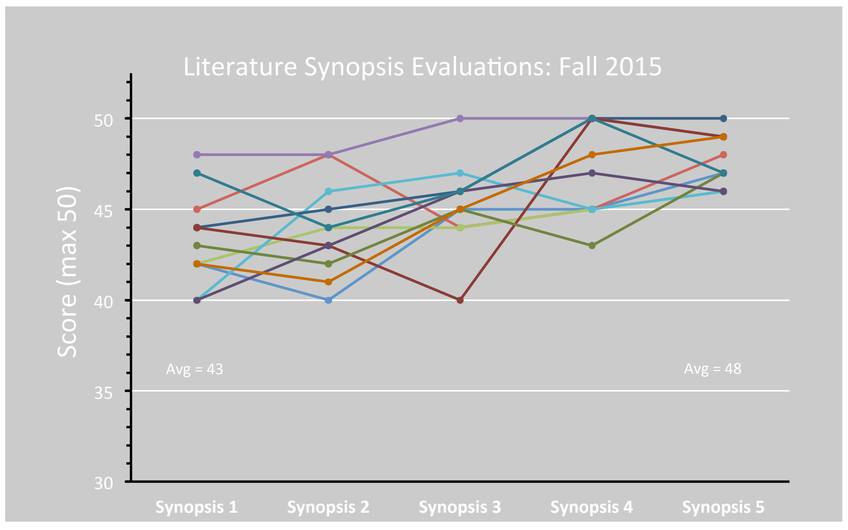
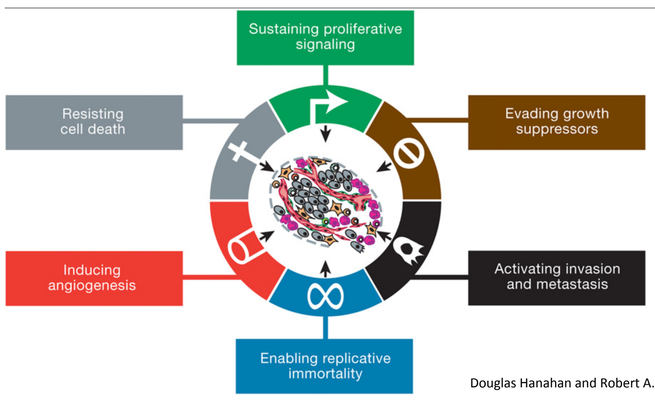


Figure 1. Eleven students participated in a journal club style discussion on five different primary research articles in the field of cancer biology. Following each in-class discussion of an article, in both small-and large-group settings, each student was instructed to create a succinct analytical synopsis of the article, discussing 1) background knowledge, 2) the hypothesis, 3) the key elements of each data figure, and 4) the major conclusions that contribute to our understanding in that scientific field. The average score is shown for the first and last synopsis. (*no rubric used for grading*)



Douglas Hanahan and Robert A. Weinberg. *Cell* 144, March 4, 2011

Cancer Biology

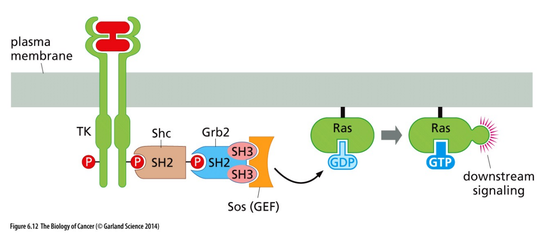


Figure 6.12 The Biology of Cancer (© Garland Science 2014)