

Domain 3 Appendix Example - William B. Davis

Representative Clicker Questions

1. A stem cell has a gain of function mutation in which the receptor's kinase activity is permanently turned on. Which of the following is the most likely outcome?

- A. Phosphorylated TF will not be found in the nucleus
- B. The receptor will no longer bind to the self-renewal ligand
- C. Phosphorylated TK₂ will not be found in the cell
- D. The stem cell will constantly self-renew since the pathway is now a permanent circuit

This question introduces students to new concepts like “gain of function mutant”, “loss of function mutant” and “permanent circuit” by placing them in context. In Spring 2016, **84%** of students got this question right after in class discussions.

2. Which of the following mutations would shut down the self-renewal pathway in a stem cell?

(A = True; B = False; C = Not enough information given)

1. The TF gene has a nonsense mutation before the DNA binding domain

This question had a **60%** success rate in Spring 2016-by this point many students had forgotten what a “nonsense” mutation in a protein was, and this question was designed to foster recall and spaced learning of material.

2nd Exam Performance in Spring 2016:

To measure student learning, Exam 2 had a copy of the stem cell renewal model and three questions related to it.

Question 1: Which of the following changes would still allow TF to enter the nucleus? (79% of students answered this question correctly on the exam)

- a) TK1 has a loss of function mutation that knocks out its kinase activity
- b) A phosphatase targeting TK2 is present in the cell
- c) The SR receptor has a loss of function mutation that eliminates TK1 binding
- d) TF has a gain of function mutation that mimics phosphorylation

Question 2: Based upon the principle of signal amplification, which of the following situations is most likely NOT observed during stem cell renewal? (65% of students answered this question correctly on the exam)

- a) TK1 only phosphorylates a single TK2 protein before it shuts down
- b) each SR ligand can lead to the production of 100 TF in the nucleus
- c) each TK2 will phosphorylate 10 TF proteins

- d) each receptor binds to a single SR ligand

Question 3: Which function does the receptor NOT carry out related to stem cell self-renewal?

- a) The receptor can phosphorylate both itself and TK1
- b) The receptor moves in the fluid mosaic membrane to dimerize
- c) The receptor shuts down signaling through its phosphatase activity
- d) The receptor is specific and only binds to the self renewal ligand

Only 42% of students answered this question correctly on the exam. This was surprising since it is a Bloom's Knowledge/Comprehension level question. Clearly something was missing in the classroom that needs to be addressed in the future.

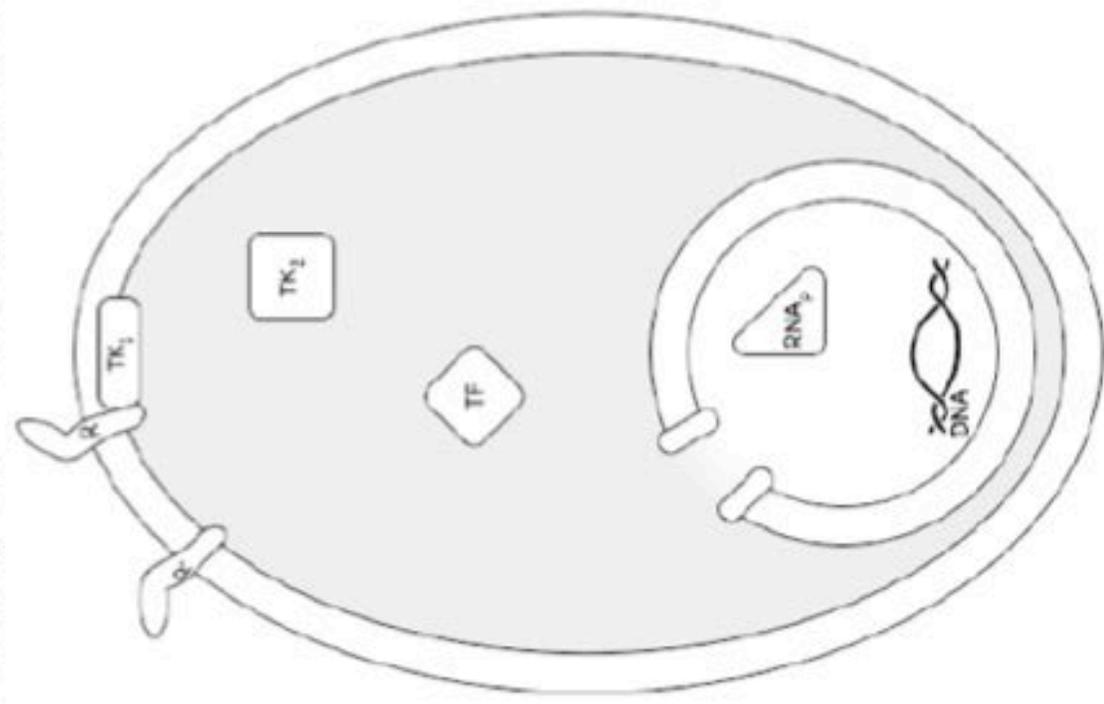
Final Exam Performance in Spring 2016:

Since this model incorporated and integrated multiple learning outcomes for the class, the figure and a question related to it were incorporated into the final exam in Spring 2016.

Question: Which of the following changes would still allow self-renewal after a signal is received by a stem cell? (85% of all students answered this question correctly on the final)

- a) TK1 has a loss of function mutation that knocks out its kinase activity
- b) TF has a mutation that eliminates DNA binding
- c) The SR receptor has a loss of function mutation that eliminates TK1 binding
- d) TK2 has a silent mutation in its kinase domain

Pathway Off - No Signal Present



SR Pathway activated by signal binding receptor

