DEGRADATOR GAME CONTENT DESCRIPTION

Overview

DEGRADATOR is a 2D platformer developed in Construct 3, freely accessible via web browsers at www.degradator-game.com and as an Android app on the Google Store. The main protagonist of the game is E3 ubiquitin ligase, an enzyme of the ubiquitin-proteasome system that recognizes and mediates the ubiquitination of its substrate proteins so that they are recognized and degraded by the proteasome. The game consists of 10 levels total - seven levels are playable, each of which begins with a graphical tutorial and ends with a brief description of the biological process presented. The maximum time to complete each level is three minutes. Player can be rewarded with one to three stars depending on the time required to complete the level. Steering is done with the mouse or touch, depending on the device. In addition to playable levels, three quizzes are also included. Passing each level unlocks the next one.

Game menu

The menu provides access to the game's 10 levels, as well as the Great Encyclopedia of Protein Degradation and Credits section. The menu is kept in a futuristic, dark blue color scheme. Two language versions are available, Polish and English. Quizzes and the Great Encyclopedia of Protein Degradation are also available in PDF format; they can be downloaded from www.degradator-game.com.

Game characters

The game features a playable character of the E3 ubiquitin ligase and various non-playable characters - the ubiquitin-conjugating enzyme E2, four distinct types of protein substrates, ubiquitin, proteasome, and deubiquitinating enzyme, as well as power-ups - adenosine 5'-triphosphate (ATP), PROteolysis TArgeting Chimera (PROTAC) compound and inhibitor of a deubiquitinating enzyme.

Level 1

The player, as a turquoise E3 ubiquitin ligase, must catch its orange protein substrate and purple E2 ubiquitin-conjugating enzyme, which then transfers ubiquitin (a small protein) onto the substrate. The player must repeat this process four times so that the substrate receives a chain of four ubiquitins, allowing the proteasome to recognize and degrade it. Once the ubiquitin of a given E2 enzyme is spent, the player must wait for it to respawn or grab another E2 enzyme with ubiquitin available. The game ends when four orange proteins are four times ubiquitinated and degraded by the proteasome.

Level 2

This level introduces a dark blue protein that normally cannot be recognized by our hero - the E3 ubiquitin ligase. A power-up, ATP, is also introduced, which, when caught by our hero, allows the ubiquitin to be instantly respawned on the nearest E2 enzyme. The game ends when four orange proteins are four times ubiquitinated and degraded by the proteasome.

Level 3
Quiz with five single-choice questions based on short descriptions displayed after completing levels 1 and 2.

Level 4
This level introduces the mechanism of PROTAC functioning: the E3 ubiquitin ligase must catch a stick-like power-up with two different-colored ends, turquoise matching our hero and dark blue matching the dark blue protein, so that the E3 ubiquitin ligase will begin to recognize and bind the dark blue protein. This will allow for its ubiquitination by the E2 enzyme. The game ends when four dark blue proteins are four times ubiquitinated and degraded by the proteasome.

Level 5
It combines all the mechanics introduced so far: the player has to ubiquitinate one orange substrate protein and three other proteins (dark blue, yellow, green) that it normally cannot bind but is able to do so by grabbing the right PROTAC (with the end corresponding to the substrate's color, i.e. dark blue, yellow or green). The game ends when all four proteins are four times ubiquitinated and degraded by the proteasome.

Level 6
This level introduces the deubiquitinating enzyme, a major antagonist that cleaves ubiquitin from proteins, hindering their degradation by the proteasome. The player must ubiquitinate two orange, one green and one yellow proteins (thanks to catching a proper PROTAC), avoiding a deubiquitinating enzyme. The game ends when these four proteins are ubiquitinated four times and degraded by the proteasome.

Level 7
Quiz with five single-choice questions based on short descriptions displayed after completing levels 4-6.

Level 8
This level introduces an inhibitor of the deubiquitinating enzyme, which permanently disables its activity. The player must ubiquitinate two orange, one blue and one yellow proteins (thanks to catching a proper PROTAC), avoiding several deubiquitinating enzymes. The game ends when these four proteins are ubiquitinated four times and degraded by the proteasome.

Level 9
This level introduces the mechanism of auto-ubiquitination, meaning that ubiquitin is transferred to the E3 ubiquitin ligase itself when our hero remains in complex with the E2 enzyme for too long. If E3 ubiquitin ligase is ubiquitinated four times, the game ends and the level must be repeated. The player must ubiquitinate two orange, one blue and one green proteins (thanks to catching a proper PROTAC) while avoiding several deubiquitinating enzymes. The game ends when these four proteins are ubiquitinated four times and degraded by the proteasome.

Level 10
A final 12-question single-choice quiz based on descriptions displayed after completing playable levels and information from the Great Encyclopedia of Protein Degradation.