Development of game-like learning objects (GLOs) to enhance a learner-centered approach to blended learning

Betty Black and Laura Welsh
Department of Biological Sciences

Introduction
As we have begun to move toward a blended classroom format in Introductory Biology, lack of preparation by students before class has made it difficult to implement active learning during class, especially in sections that meet in large lecture halls. Biology textbooks and online publisher’s materials are not well working for learning outside of class, and these materials are becoming a financial burden for our students. Thus we wish to provide online materials for use before classes that are cost-free, engaging, and more likely to stimulate student interest in biological content and motivation to learn. We are developing online modules in the form of game-like learning objects (GLOs). Each GLO covers basic concepts in a selected topic of biology. Learning objectives of the GLO are presented as quests, with each quest taking the student to a scientific article, narrated slide-show, video clip, or interactive simulation, followed by assessment questions with immediate feedback. The GLOs are entirely html5/JavaScript format for universal usage and are easy to edit and customize for a variety of purposes. A GLO developed for Introduction to Cells will be shown and the game-like features discussed.

Goal
The overarching goal of the project is to facilitate student-centered instruction in first-year college biology through the development and implementation of digital, game-like learning objects (GLOs).

Specific Objectives
Produce GLOs that cover the basic concepts in the 2-semester sequence in Introductory Biology (BIO 181 and 183) taken by most students in Life Science majors at NCSU. Add an elementary difficulty level and challenge level for each GLO to provide an adaptive learning component. Collaborate with Biology instructors at NCSU to increase active learning strategies of teaching and learning that coordinate with the GLOs. Assess the impact of GLOs on depth of learning and motivation of students in BIO 181/183.

Considerations in Development of GLOs
GLOs should run on most platforms, including tablets and hand-held devices. Each GLO should be modular to allow simple editing and customization. GLOs should not contain copyrighted materials. GLOs should meet ADA compliance guidelines. The user interface and GLO controls should be intuitive and provide flexibility of movement. The GLOs should provide challenges with immediate feedback for students.

1. The cell is the fundamental unit of structure and function in all living things.
2. All living things are composed of cells.
3. Cells come only from pre-existing cells.

The modern cell theory states that the cell is the fundamental unit of structure and function in all living things. Cells come only from pre-existing cells. Scientists use microscopes to examine cells. However, we are not yet able to distinguish the single cell.

What are Cells?
By Byron Hollins

About Cells
All living things are made of cells, which are the basic unit of life. Cells are so small that they are often invisible to the naked eye.

What is a cell? A cell is a self-sustaining unit of life, allowing for growth, development, and reproduction.

Cell Structure
- Cytoplasm: The liquid matrix that surrounds all the organelles.
- Nucleus: The control center of the cell, containing the DNA.
- Mitochondria: The powerhouse of the cell, producing energy.
- Ribosomes: Sites of protein synthesis.
- Endoplasmic Reticulum: Produces cell wall materials.

Cell Function
-photosynthesis: the process by which plants convert light energy into chemical energy.
- ATP: Adenosine Triphosphate, the energy currency of the cell.

Modern Cell Theory
Students visit the portrait gallery to gain a historical perspective that led to the current cell theory. Clicking on one of the names brings up a portrait of the scientist and a summary of his
t contribution to our understanding of cells. Hooke is currently selected in this interactive learning object.

Origin of Cells
Clicking the clock brings up a “time machine”. Students watch a narrated slide show that takes them back in time to early earth, when organic molecules and then the first cells where beginning to form.

Cell Quest

GLO Prototype for Introduction To Cells
This prototype is designed for the topic Introduction to Cells. Students click on Begin Your Quest to hear a brief introduction by the professor guide, Dr. Black, and view the Quest Board. They then begin each quest, as indicated on the board, by accessing each of 7 hot spots represented by icons. A new page that pops up from each hotpot will display a digital asset as follows:

- Bookshelf—an introductory article on cells; Portrait gallery—a history of the cell theory featuring Hooke, Schleiden and Schwann, and Virchow; Graph—it an interactive simulation depicting the relationship between cell size and volume; Bacteria—a narrated slide show depicting basic cell structure and the types of microscopes used to study cells; Microscope—a virtual microscope that allows students to study a light micrograph of cells by moving the “slide” and changing magnification; Clock—video of a narrated trip in a time machine to learn the conditions of early earth and view the formation of the first cell-like structures; Beaker—an interactive animation about experiments to create organic molecules and cell-like structures in the laboratory.

Quest Board
Clicking on Begin Your Quest brings up this list of quests. When a quest has been completed, a check appears in the adjacent box.