



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

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## 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 working well 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 handheld 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.

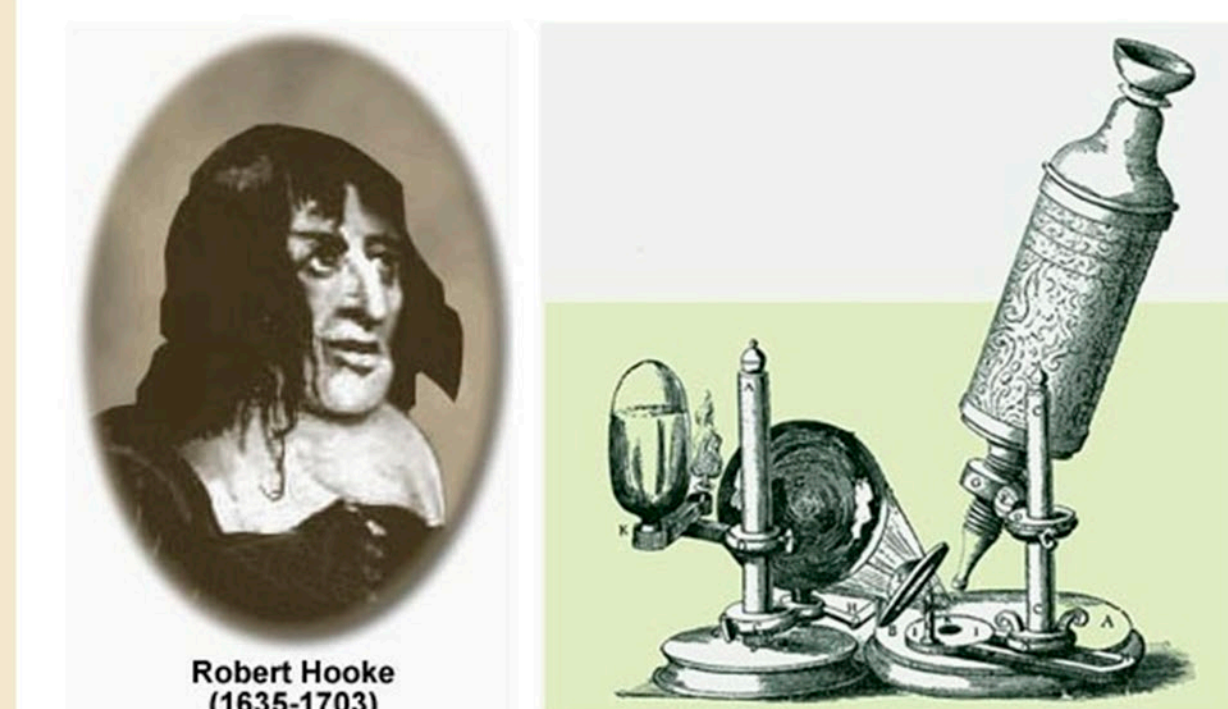
The GLOs should provide challenges with immediate feedback for students.

## Modern Cell Theory

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 the three points listed above, although the original theory proposed only the first two. To learn a brief history of the cell theory, click on the names of the early biologists listed below who contributed to the theory.

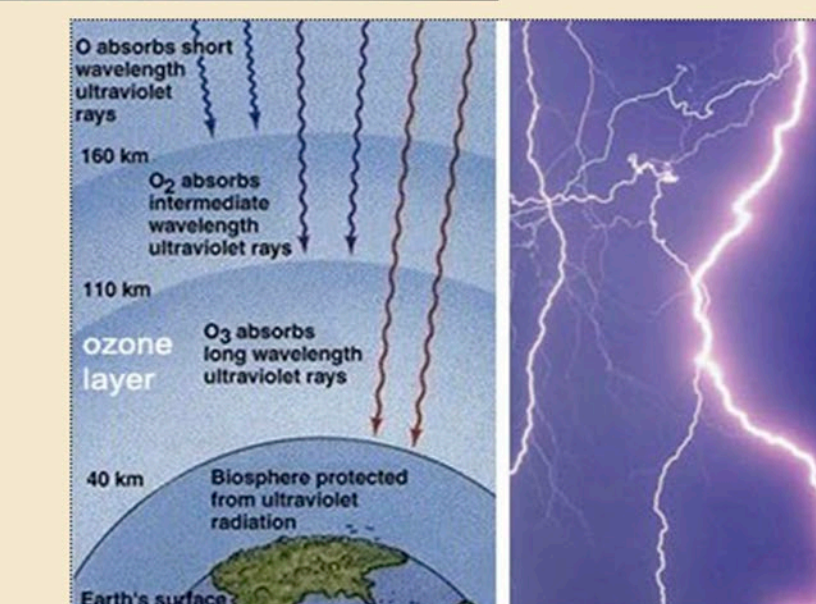
Hooke      Schleiden and Schwann      Virchow



Robert Hooke (1635-1703)  
Before the cell theory was accepted (in the 19th century), everyone assumed that plants and animals were made of simple substances resembling non-living materials. Robert Hooke, in 1665, was the first scientist to utilize a microscope to observe tissue. He examined thin slices of cork under one of the first primitive microscopes and observed an image that contained rectangular structures that reminded him of the cells in a monastery. Hence the name "cells". However, no one yet realized the significance of this observation.

## History of the Cell Theory

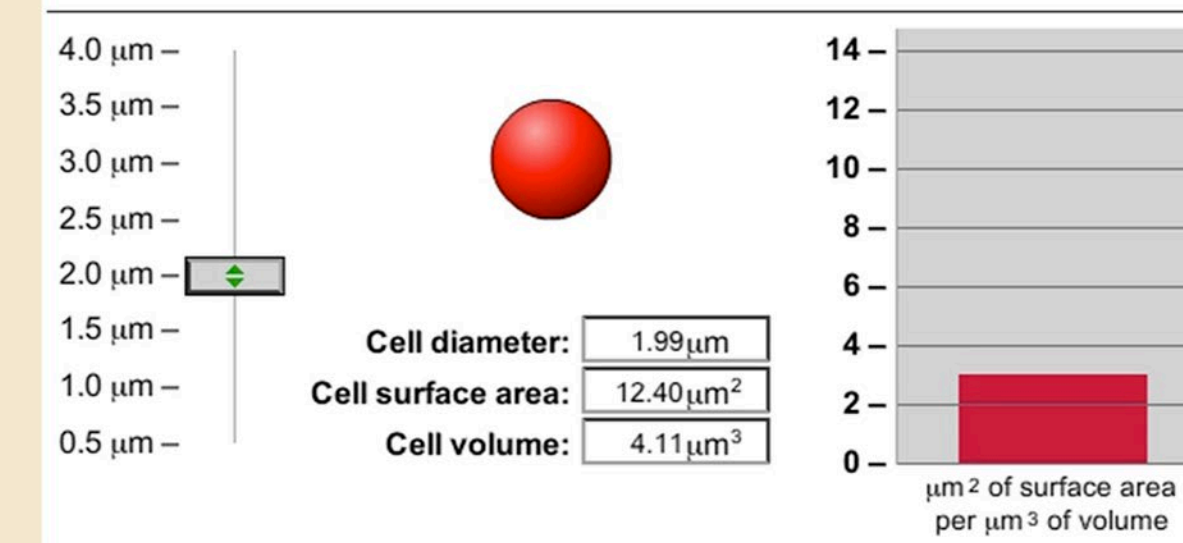
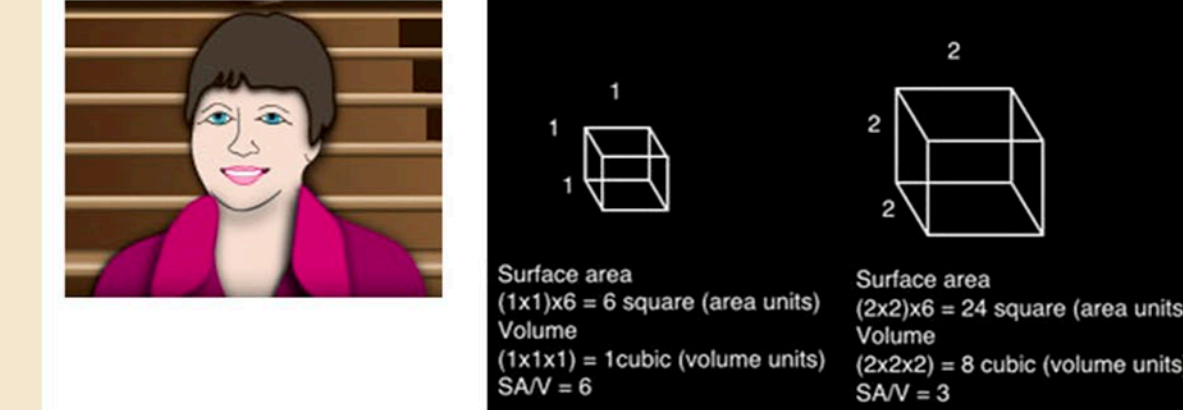
Students visit the portrait gallery to gain a historical perspective that led to the current cell theory. Clicking on one of the names brings up a portrait of the scientist and a summary of his contribution to our understanding of cells. Hooke is currently selected in this interactive learning object.



## 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 were beginning to form.

## Change in surface area and volume as a 3-D object grows



## Cell Size and Surface Area/Volume Ratio

Clicking the graph symbol brings up this interactive learning object. Students first listen to a narration from their professor-guide based on the image in the upper right. Then, they manipulate the graph below and watch how increasing cell diameter changes the surface area/volume ratio.

## What are Cells?

By: Byron Norelius

### About Cells

A cell is the basic unit of life. All living organisms are composed of one (unicellular) or more (multicellular) cells. In unicellular organisms, like many protists and bacteria, specialized parts of the cell perform all of the organism's vital functions. In multicellular organisms, like humans, specific types of cells are bound to each other to create tissue, which makes up the organs of the vital body systems that together keep the entire organism alive. Cells of one tissue type can be completely different than cells of a different tissue type. Different organisms with different evolutionary histories show adaptations on the cellular level as well. Even within the same genus of a specific organism, cells of the same tissue type may show uniqueness on the species or even the individual level.

called a cell wall. The cell wall protects against mechanical stress and keeps the cell from becoming over-filled with water.

Within the cell are the organelles, some of which can be seen with the aid of a compound microscope. The nucleus is a large, often rounded organelle. Most animal and plant cells have a nucleus, which contains a copy of the DNA of the organism (a notable exception would be mammalian red blood cells, which lack a nucleus). Chemically coded on the DNA are the instructions to produce every protein an organism needs to make new cells, digest foods, produce necessary chemicals, move, and all other cell-level life functions. The exact sequences are copied inside the nucleus by molecules of messenger RNA (mRNA), which pass out of the

## Article on Cell Basics

Clicking on the bookshelf brings up this short article that addresses "What is a cell? And describes the basic structure of a cell. This is high school level biology, but serves as a good introduction to the topic.

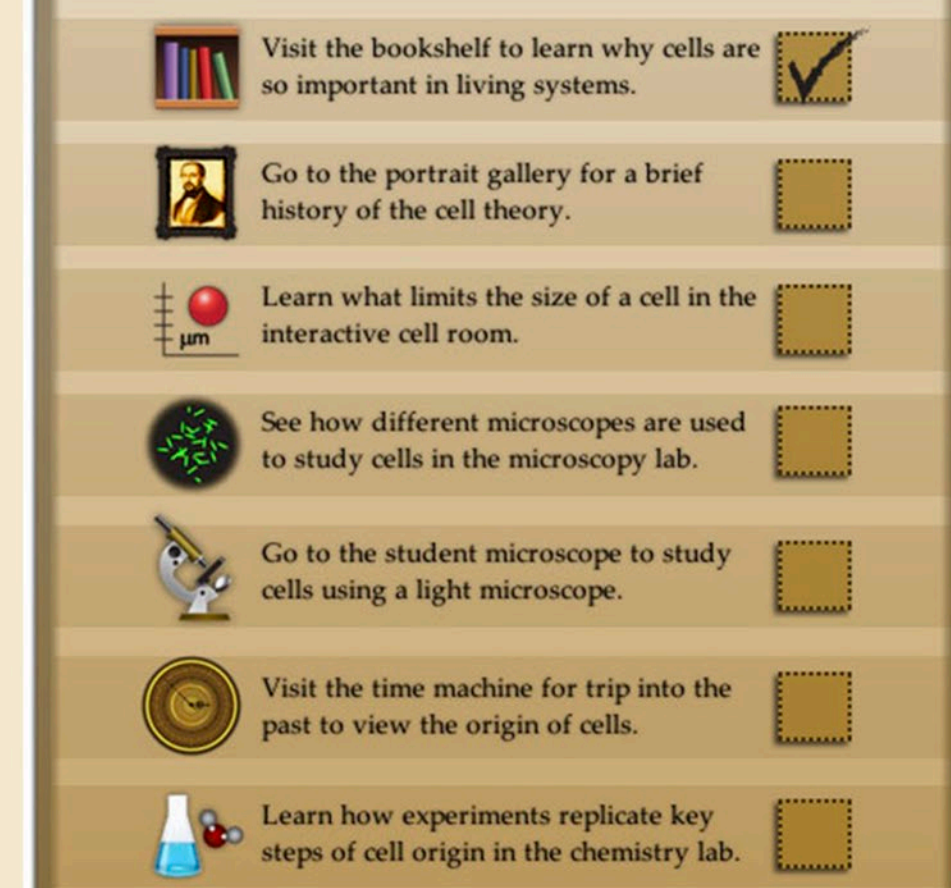


## GLO Prototype for Introduction To Cells

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*--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 the student 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



## 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.