Statement of Work

**Project**: BioRube Bot iPad Development

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**Athens State Representative**: Professor Maxwell

**Project Owner**: Dr. Sara Cline

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## Scope

A team of dedicated students will be working on the BioRube Bot iPad Application for Dr. Sara Cline.

## Requirements

This project will be a continuation of past work that has been done in Educational Game Development for Dr. Sara Cline in the Biology department. Past work has not only led to the development of a mobile educational game but has also allowed faculty and students to publish research with the Association of Computing and Machinery (ACM). Our team of students will be assigned to work with Dr. Cline in the Fall 2021 semester to do the following task:

(1) update the game to be compatible with the current operating system updates for iPads

(2) Remove the penultimate level as it is too easy

(3) and lastly create a new level based on G-Protein Signaling Video.

**Behavioral Requirements**

**Level 2 Artifacts**

**G-Protein Coupled (GPC) Receptor**

A picture containing text, tableware, dishware

Description automatically generated

G-Protein shall await activation once placed in the cell membrane.

G-Protein shall become receptive to a Trimeric G-Protein once a Signaling Molecule binds with it.

**Activated G-Protein Coupled Receptor’**

![Text

Description automatically generated]()

**Signaling Molecule (Protein Ligand)**

BioRube Bot shall allow the user to place a Signaling Molecule outside of the Cell Membrane, but not inside.

Signaling Molecule shall seek the G-Protein receptor to activate it.

**Trimeric G-Protein**

![Graphical user interface, application

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BioRube Bot shall allow the user to place a Trimeric G-Protein on the cell membrane wall.

The initially spawned Trimeric G-Protein shall include GDP in the Alpha-Subunit.

The Trimeric G-Protein shall bind to the cell membrane via the lipids.

The Trimeric G-Protein shall seek an activated GPC Receptor with which to bind.

The Trimeric G-Protein shall bind with an active GPC Receptor once located.

G-Protein shall drop its GDP when it becomes activated by the Trimeric G-Protein.

With no GDP attached, the G-Protein shall be receptive to a GTP.

When GTP binds with the activated GPC Receptor, the Trimeric G-Protein shall separate from the GPC Receptor.

**Alpha Subunit**

Alpha subunit with GDP is inactive. Alpha subunit that has GTP is active.

Inactive alpha subunit shall seek the Beta Gamma complex if they are not together.

Active Alpha Subunit shall seek Adenylyl Cyclase.

When GTP binds with the activated GPC Receptor, its GDP shall break off.

When the Trimeric G-Protein separates from the GPC Receptor, the alpha subunit shall split off from the Beta-Gamma Complex.

The Alpha Subunit, once separated from the Beta-Gamma Complex shall seek an Adenylyl Cyclase with which to bind.

The Alpha Subunit shall bind with the Adenylyl Cyclase.

When the GTP within the Alpha Subunit hydrolyzes and turns into GDP, the Alpha Subunit shall break away from the Adenylyl Cyclase and seek the Beta-Gamma Complex.

**Beta-Gamma Complex**

When the Trimeric G-Protein separates from the GPC Receptor, the Beta-Gamma Complex shall split off from the Alpha Subunit.

**GTP**

BioRube Bot shall allow the user to spawn GTP within the cell membrane.

Once spawned the GTP shall seek an active and GTP-receptive G-Protein Receptor.

The GTP shall bind with a G-Protein Receptor.

After 45 seconds, the GTP bound to the G-Protein receptor shall hydrolyze.

Once hydrolyzed, the GTP shall transform into GDP.

**Adenylyl Cyclase**

BioRube Bot shall allow the user to spawn an Adenylyl Cyclase on the Cell Membrane.

The Adenylyl Cyclase shall adhere to the cell as depicted in **Figure 1**.

![Icon

Description automatically generated with medium confidence]()

*Figure 1: Adenylyl Cyclase Cell Binding*

The Adenylyl Cyclase shall await activation via the Alpha-Beta Subunit.

Once the Alpha Subunit binds with the Adenylyl Cyclase, the Adenylyl Cyclase shall become active.

Once activated the Adenylyl Cyclase shall undergo a transformation.

An activated Adenylyl Cyclase shall transform ATP into cAMP.

When the Alpha Subunit loses its GTP, the Adenylyl Cyclase shall become inactive.

**ATP**

With an activated Adenylyl Cyclase in the Cell Membrane, ATPs shall become cAMPs.

With an activated PKA spawned within the Cell Membrane, ATP shall seek a transcription regulator with which to bind.

**cAMP (Cyclic AMP)**

**GDP**

When GDP breaks off from the alpha subunit, it shall leave the game.

**Protein Kinase (PKA)**

BioRube Bot shall allow the user to spawn Protein Kinase (PKA) within the cell membrane.

PKA shall seek cAMP with which to bind.

PKA shall bind with cAMP.

Once bound with at least two cAMP the PKA shall become activated.

An activated PKA shall separate its Inhibitory Protein and Kinase.

**Inhibitory Protein**

**Kinase**

The Kinase, once separated from the Inhibitory Protein shall seek a Transcription Regulator with which to bind.

**Nuclear Pore Complex**

BioRube shall allow the user spawn a Nuclear Pore Complex on the cell membrane.

**Transcription Regulator**

With an activated PKA within the cell, a spawned transcription regulator shall bind with the Kinase.

**Checkboxes**

BioRube Bot shall include seven checkboxes for level 2.

**CB1**

Checkbox one shall become checked after the G-Protein Coupled Receptor is activated.

**CB2**

Checkbox two shall become checked after the Trimeric G-Protein binds with the G-Protein Coupled Receptor.

**CB3**

Checkbox three shall become checked when the Trimeric G-Protein binds with a GTP and breaks apart.

**CB4**

Checkbox four shall become checked when the alpha subunit binds with the Adenylyl Cyclase.

**CB5**

The fifth checkbox shall become checked after the Alpha Subunit rejoins the Beta-Gamma Complex as the Trimeric G-Protein.

**CB6**

The sixth checkbox shall become checked after the PKA becomes active.

**CB7**

The seventh checkbox shall become checked after the Transcription Regulator enters the nucleus via the nuclear pore complex.

Video Reference Link: https://youtu.be/hrOYk33juS8

## Task

* Reorganize the file structure of the project
* Update the game to be compatible with the current Operating System updates for iPads
* Remove the penultimate level
* Create a new level based on the G-Protein Signaling Video
  + Design new graphics
  + Incorporating new mechanics
  + New specific features

## Product Functionality

This will consist of a description of what changes were made (Ex. What we did for the merging of two levels, what we added/created for the new last level, and what we did to fix the OS issue)

## Non-Functional Requirements

1. Performance – The game will run more smoothly than the previous version.
2. Reliability – The goal is to limit crashes and/or new bugs/glitches.
3. Availability – The game will be made available on the app store.
4. Security – Limit any compromised cases based on ethics and copyright laws.
5. Maintainability – Make the code/graphics easier to manage should anything need changing.

## User Stories

* As a user, I want the BioRube Bot game to run on the latest version of IOS so that I can play it on an updated Apple Tablet.
* As a player, I want each successive level of gameplay to be enough of a challenge to hold my interest so that I am not disappointed or bored by level completion.
* As a college biology student, I want the BioRube Bot game to help me learn the concepts my instructor is teaching me so that I can remember the concepts when I take the test.
* As an elementary school student, I want to have fun playing the BioRube Bot game so that I can learn the biology concepts without having to put a lot of effort into focusing on a lecture.
* As a biology instructor, I want the BioRube Bot game to be intuitive enough that it is self-documenting for my students so that they can learn uninterrupted by confusion about the game’s operation.
* As a biology instructor, I want the BioRube Bot game to help my students learn the concepts of the G-Protein so that they can complete my class with an understanding of the concepts.
* As a player, I want to learn about G-Protein signaling so that I can pass my exams.

## Monitoring and Quality Assurance

The BioRube Project team will meet weekly or bi-weekly to discuss the project. Throughout those meetings the group will meet with Dr. Cline for her input. Zoom and the campus at Athens State University will be the methods for meeting.

## Project Iteration Plan and milestones

* Milestone: Setup to Work (September 5)
  + Set up development environment (Unity, Visual Studio, GitHub, Subversion) (August 29)
  + Discuss and agree on branch and check-in procedure. (September 5).
  + Review Previous semester’s work to familiarize ourselves with the current state of the code, assets, and scripts (September 5)
  + Get the project to compile without errors (September 5)
* Milestone: Resolve broken build issues
  + Determine how the C# language and other aspects of the build environment have changed since the last executable build and left the project in a broken state. (September 12)
  + Modify code as necessary to bring it up to date without losing functionality. (September 12)
* Milestone: Remove penultimate level as requested by Dr. Cline
  + Identify code pertaining to the final level. (September 19)
  + Determine path for removing the level without losing anything the user needs in order to complete the final level. (September 26)
* Milestone: Complete new final level
  + Determine full requirements for the new final level. (October 3)
  + Determine path forward for meeting requirements of new final level (October 10).
  + Create any new game assets for the new final level (October 31)
  + Write behavioral code for the new final level (November 14)
* Milestone: Complete integration and regression testing
  + Test that functional requirements met by previous team are still met (November 21)
  + Test that the new level works without any errors and that it fits into the game as a whole. (November 21).
* Milestone: Write documentation for user and for future developers (November 28)

*Agreement of Project Requirements*

*By signing this Statement of Work, you agree that the tasks that are currently listed in the document fulfill all the requirements and expectations associated to the project at hand. Once approved sponsors can make requests for additional tasks to be added to the project, however the team is not able to guarantee their completion within the given time frame. If there is any disagreement or additional requirements that must be added to the SOW those changes must be documented before this agreement is signed. The SOW currently fulfills the minimum expectations and requirements of the overseeing faculty member.*

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| --- | --- | --- | --- |
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