**BioRube Bot Requirements**

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# Requirements

The requirements highlighted in yellow have been met and have been thoroughly tested. Those that are highlighted in red are unmet. What is not highlighted and does not include the word ‘shall’ is not a requirement, but rather a description.

## Behavioral Requirements

### Level 2 Artifacts

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

A picture containing text, tableware, dishware

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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

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#### 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 hydrolized, 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**.

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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.