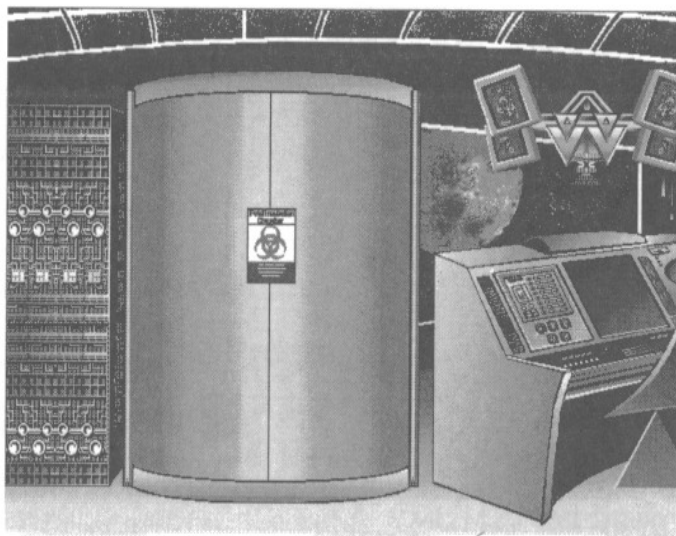


# ***G-NETIX***

**THE BIOENGINEERING SIMULATOR**

**USER'S GUIDE**



# ***G-NETIX***

## ***USER GUIDE***

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# G-NETIX

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## **Contents**

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<b>License</b>	<b>4</b>
<b>Installation</b>	<b>5</b>
<b>Object of the Game</b>	<b>6</b>
<b>Launching the Program</b>	<b>6</b>
<b>Game Overview</b>	<b>7</b>
<b>Game Walkthrough</b>	<b>9</b>
<b>The Embryo Control Window</b>	<b>18</b>
<b>Fixing Mutated Cells</b>	<b>20</b>
<b>The Gene Sequencer</b>	<b>23</b>
<b>Combating Infections</b>	<b>28</b>
<b>Testing the Embryo</b>	<b>29</b>
<b>Adult Tests</b>	<b>31</b>
<b>Appendices</b>	<b>36</b>
<b>A. Environmental Factors</b>	<b>36</b>
<b>B. Late Stage Diagram of Body Parts</b>	<b>38</b>
<b>C. Protein Analysis</b>	<b>39</b>
<b>D. Gene Description List</b>	<b>49</b>
<b>E. mRNA Sequence List</b>	<b>69</b>
<b>F. Bacteria Samples</b>	<b>80</b>

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## Installation

G-Netix requires a Macintosh computer with a hard disk and a minimum of 7 megabytes of free space. The black and white version needs a minimum of 2 megabytes of RAM and the color version a minimum of 4 megabytes of RAM. The black and white version will run on a color Macintosh, but the color version will not run on a black and white Mac.

Before installing the program, make backup copies of all disks. Make sure the write-protect tabs on all G-Netix disks are in the open position (the "write-protect enabled" position).

# G-NETIX

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To install G-Netix, insert Disk 1 into the computer. Open the disk and locate the Installer. Launch the Installer by double-clicking on its icon. Follow directions displayed.

## Playing the Game

### Object of the Game

A plague has destroyed all life forms on Earth. You are a biologist who was sent into space to study genetic engineering before this catastrophe. You are the only person alive and the only one who can repopulate the world with healthy human beings. The object of your research is to correct cell mutations within developing embryo samples to insure this happens. Any number of problems can arise during the growth process, from infections to mutating genes. However, you have a number of tools which will allow you to monitor and correct any potential defects.

### Launching the Program

Double-click on the **G-Netix** icon to begin the game. You may quit at any time by selecting **Quit** from the **File** Menu.

When the Control Room appears onscreen, you can select **Advanced Level** from the File Menu's **Set Game Level** or leave it at the default **Basic Level** setting.

# User Guide

Click on the control panel in the laboratory to initiate a new embryo development. The **Embryo Control Window** will appear and the doors to the incubation chamber will open. You will see the sperm fertilize the egg and the embryo begin to develop (Fig. 1).

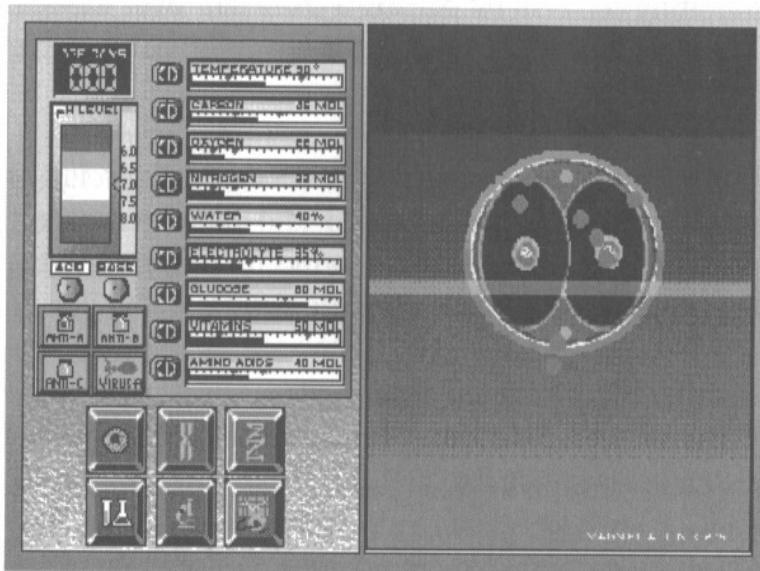


Fig. 1 The Embryo Control Window

## Game Overview

While playing the game infections must be treated with the appropriate antibiotic. In the **Basic Level**, the embryo will exhibit numerous mutations which will need to be fixed. In the **Advanced Level**, the embryo will initially display no mutations, but will undergo mutations as time progresses.

# G-NETIX

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You may need to refer to the genetic tutorial to understand the concepts of genes and mutations.

The monitor will display mutations as orange dots on the embryo. Once a mutation is detected you will have to obtain specific information about that abnormal cell in order to repair it. First, determine the body part the mutating cell is in by placing a cross hair over the cell. The body part will appear in the lower left hand corner of the screen.

By analyzing the proteins in that body part, foreign or missing proteins can be noted and the chromosome containing that gene can be found by referring to the **Chromosome Map** (see separate sheet).

In order to fix mutated genes you must first go into the **Chromosome Selection Mode** and select the specific chromosome to be fixed.

Once the chromosome is selected, you will enter the **Gene Sequencer**. Here labels are used to find the start of the amino acid sequence of the mutated chromosome. The sequence is examined and compared with the correct sequence. The **Splice**, **Clone**, and **Paste** functions are used to repair the mutation. Correct sequences may be stored in the **Gene Library** for future use. When the chromosome is repaired, you can return to the **Embryo Mode** to begin fixing the next mutation.

Mutations can be fatal. If a fatal mutation occurs a warning will be displayed. You will have to fix the mutation within the time limit or the embryo will die.

Fatal mutations appear as red dots instead of the orange dots of non-fatal mutations.

At the 12th week (Day 84), control will be taken from you and the embryo will be force-grown to its adult form. You will then be taken back to the Control Room where you will be shown the adult. If it is a healthy human, you have successfully recreated the human race and the game is over.

If it is imperfect and you are in the Basic Level, you can click on the Control Panel to return to the Embryo Mode. There you will be presented with a list of mutations you failed to fix. You will then be given a choice of creating a new embryo or cloning the old one for further work. You can also change the game from the Basic to the Advanced mode.

If it is imperfect and you are in the Advanced Level, you will have to perform adult tests to determine which mutations you failed to fix. When done, you will click on the Control Panel to return to the Embryo Mode. There you can either begin again with a new embryo or clone the old one to continue your work.

Read the genetic tutorial to familiarize yourself with basic information about genetics.

## Game Walkthrough

The following is an example of a typical scenario that might occur during game play. It is included here to give the player a feel for the mutation repair process.

# G-NETIX

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After launching G-Netix players will find themselves in their space station laboratory. Clicking on the control panel on the right side of the screen will open the door of the Fetal Incubation Chamber and display the Embryo Control Window (Fig. 1, page 7).

Mutated cells detected by the scanner appear as orange dots. The cross hair is dragged over the orange dot on the embryo's head until it snaps into place (Fig. 2). The word "Eyes" appears in the lower left hand corner of the window. This shows the selected mutation is occurring in the eyes.

The **Protein Analysis** button is clicked and the Protein Analysis screen appears (Fig. 3). Since the mutation is taking place in the eyes, click on the eye region of the drawing. The list which then appears to the left is compared with the Protein Analysis List in Appendix C for discrepancies (the Protein Analysis List shows the proteins a healthy human will display in this mode). It can be seen that the Epidermal Growth Factor Receptor is [G] (for Gorilla), instead of [H] (for Human). Referring to the **Chromosome Map** (which is included on a separate sheet), the Epidermal Growth Factor Receptor is found to be the second gene on Chromosome 7.

Once the chromosome location is determined, the Protein Analysis button is clicked to leave the Protein Analysis mode. Making sure the mutated eye cell still has the cross hair over it, the **Chromosome** button is then clicked to enter the Chromosome mode (Fig. 4, page 13). The embryo's chromosomes will appear to the right of the control panel. As it contains the mutated gene, Chromosome 7 is double-clicked and an enlarged view

# User Guide

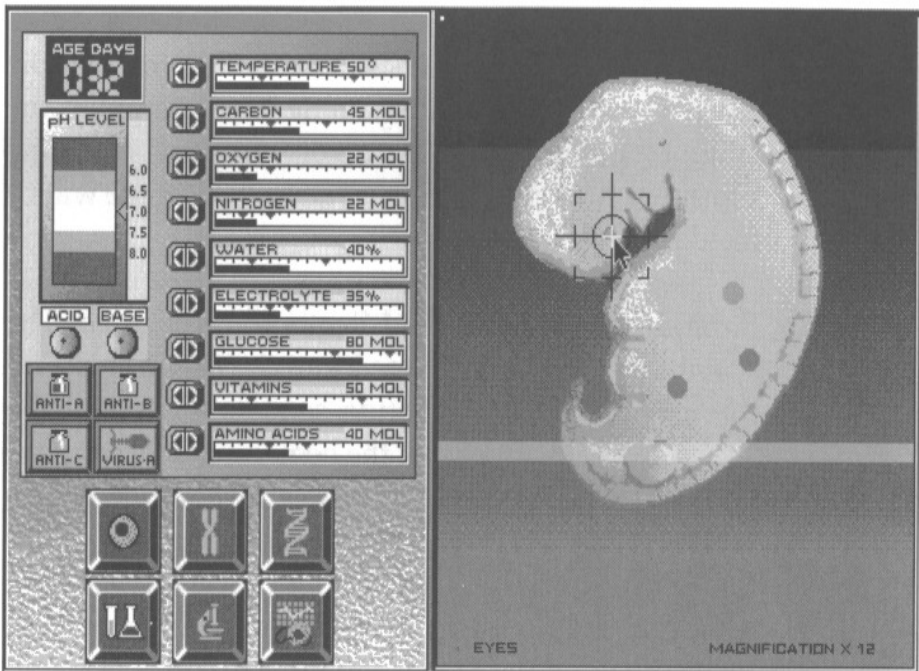


Fig. 2

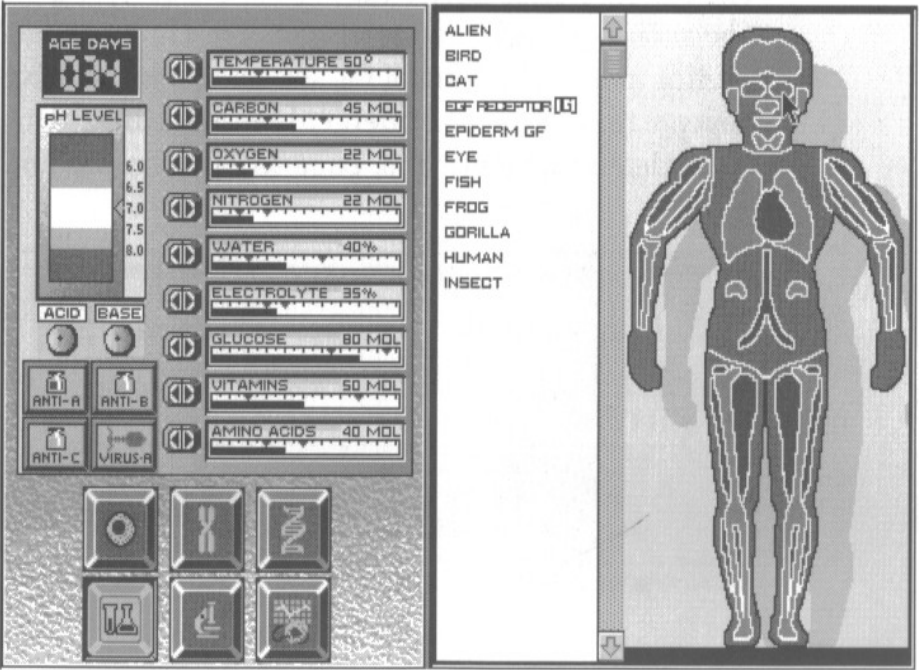


Fig. 3

# G-NETIX

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of the chromosome then appears (Fig. 5). This chromosome is double-clicked at the top to open the **Gene Sequencer** at the beginning of the chromosome (Fig. 6, page 14). The lower window contains Chromosome 7 from the eye. The mutated gene will be fixed in this window.

From the **Edit Menu**, **Find Sequence** is selected. The sequence ATATTTA is typed into the resulting dialog box (Fig. 7). This nucleotide sequence is called the **TATA box** and appears at the beginning of every gene within a chromosome. Press **Find** and the chromosome scrolls to the beginning of the first gene. Since the Epidermal Growth Factor Receptor gene is the second gene in the chromosome, this process will have to be repeated. From the Edit Menu **Find Again** is selected.

The selection now shows the start of the second gene. The mouse is click-dragged under the chromosome, starting at the beginning of the selected region. A label box containing the word **Intergenic** appears (Intergenic is the default label) (Fig. 8, page 15). By clicking and

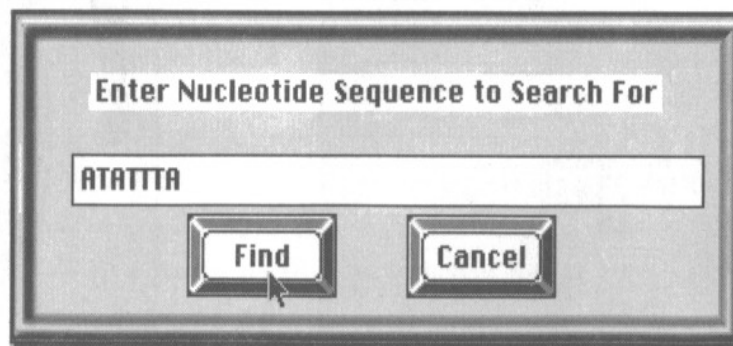


Fig. 7 Find Sequence Dialog Box

# User Guide

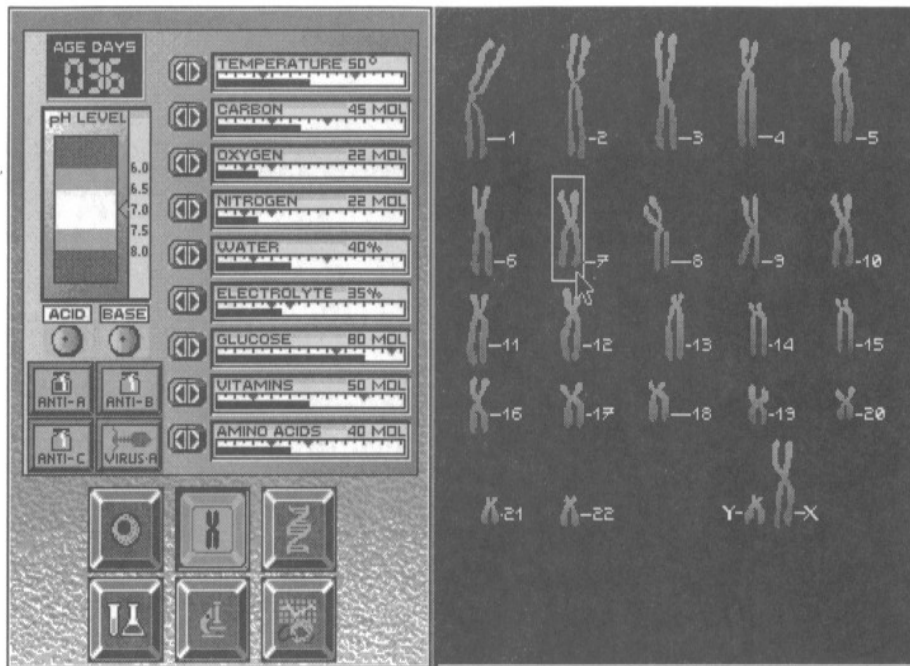


Fig. 4 Chromosome Mode

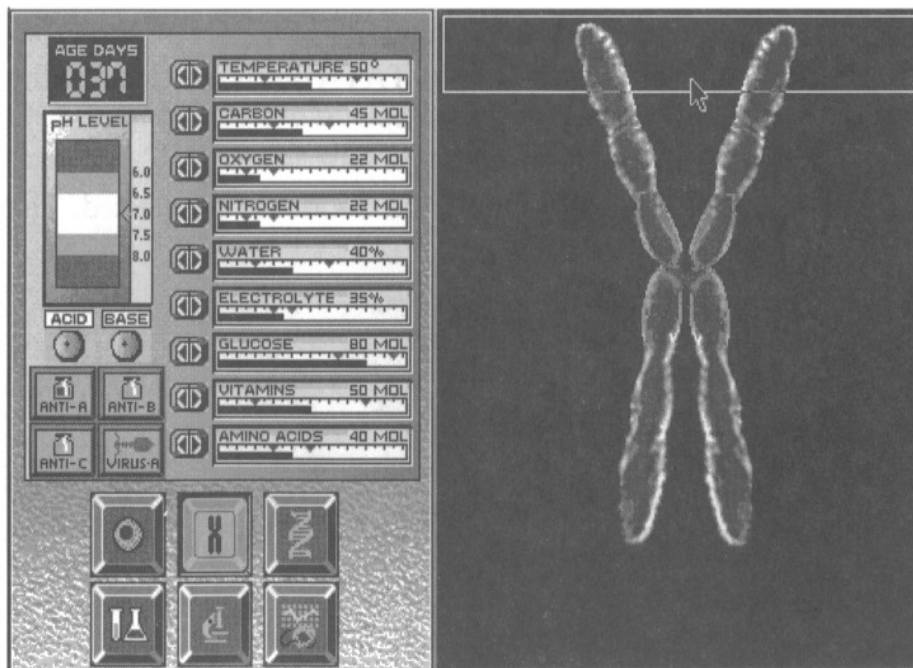


Fig. 5 Enlarged View of Chromosome

# G-NETIX

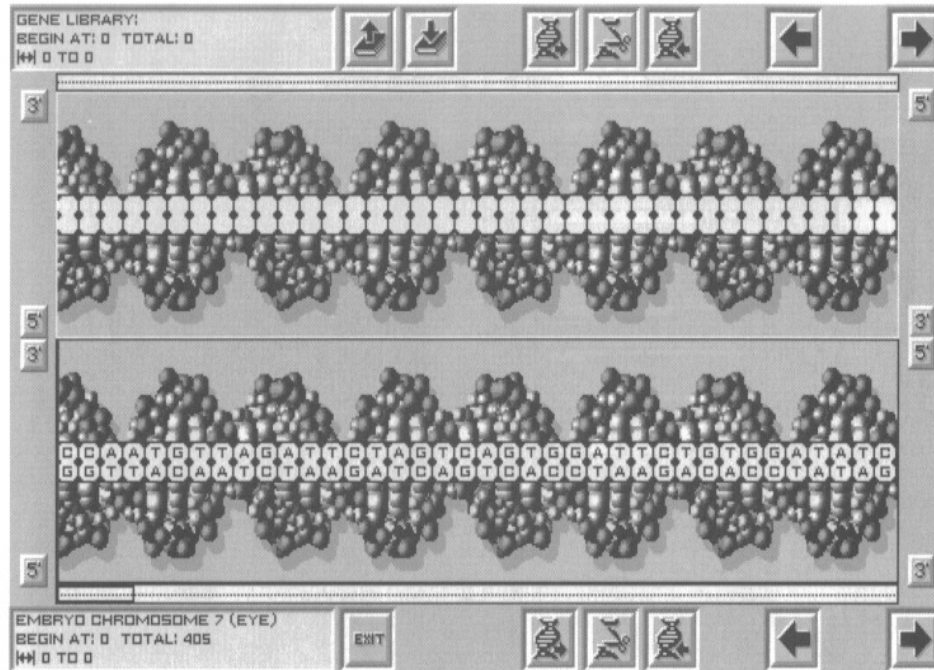


Fig. 6 The Gene Sequencer

holding the mouse in the Intergenic label box, the **Label** Menu will appear (Fig. 9). **TATA box** is selected and the label changes.

From the Edit Menu, Find Sequence is selected. The sequence TAC is typed in. This is called the **Start Codon**. This sequence is used to find the start of the amino acid sequence within the gene. The Find button is clicked. TAC will be selected in the gene string. A second label (Start Codon) is placed under the new selection.

Beginning at the end of the Start Codon label, an **Amino Acids** label is created to identify the amino acid sequence. This sequence immediately follows the Start Codon. Its



# G-NETIX

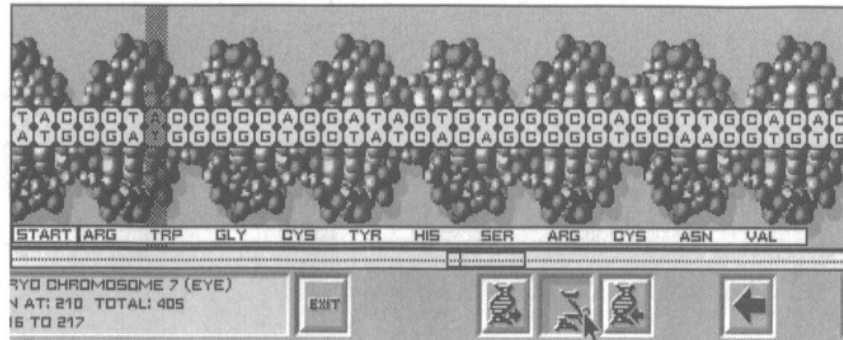


Fig. 10 Splicing a Nucleotide

sequence. Since Appendix E lists the complementary mRNA strand, the lower nucleotide sequence should be examined.

A closer look reveals that the nucleotide sequence is CGATGG. According to Appendix E, it should be CGAAGG. The "T" is incorrect and must be changed to an "A."

The "T" is selected and the **Splice** button is pushed (Fig. 10). The "T" is removed.

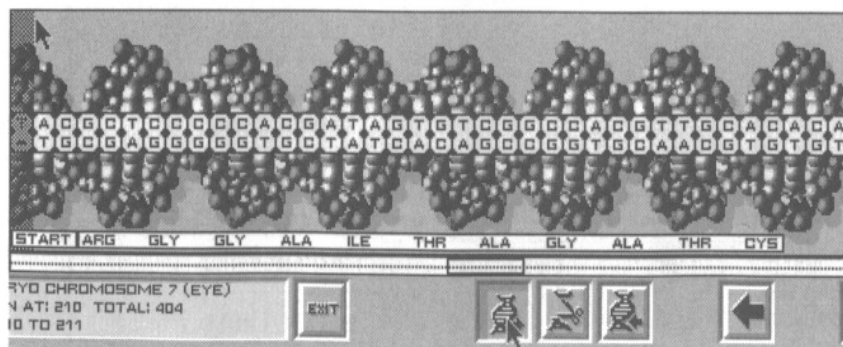


Fig. 11 Cloning a Nucleotide

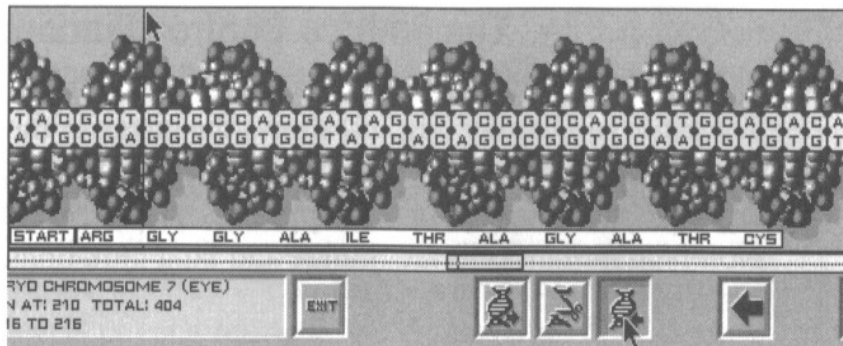


Fig. 12 Pasting a Nucleotide

Any "A" on the lower strand is selected and the **Clone** button is pushed (Fig. 11). There is no visible effect, but a copy of the "A" is now in storage, ready to be pasted. The insertion point is positioned with the mouse to place the "A" where it should be. The **Paste** button is then pushed (Fig. 12).

The sequence now matches that in Appendix E. The mutation has been repaired (Fig. 13).

Click the **Exit** button to leave the Gene Sequencer. You are now ready to repeat the process.

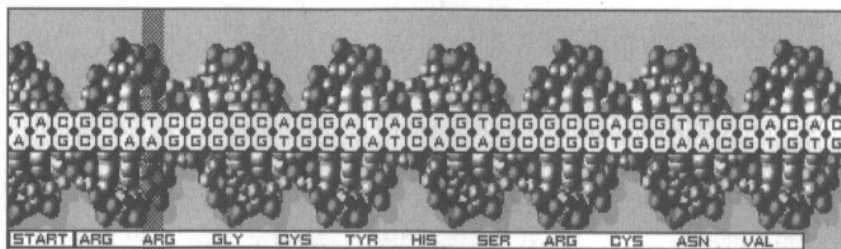


Fig. 13 Corrected Nucleotide Sequence

# G-NETIX

## The Embryo Control Window

The **Embryo Display** (Fig. 14) shows the image of the embryo at its current level of development as well as any mutant cells. Mutant cells appear as flashing dots. Non-fatal mutant cells are orange and fatal mutations are red.

The **Time** display shows the number of days since fertilization. Click on this display to set it to decimal day mode. The embryo is most sensitive to mutation during the first 84 days of development. Therefore, it can be

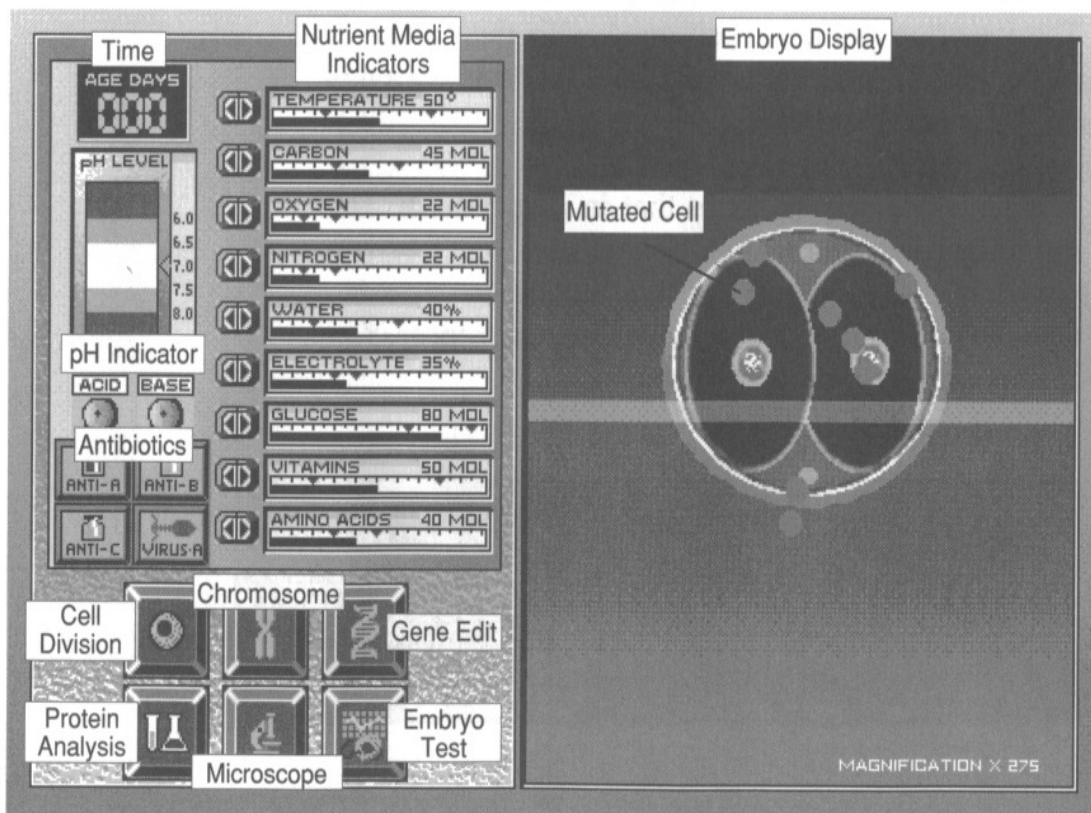


Fig. 14 Embryo Control Window

# User Guide

treated only until it is 84 days old. At that time no further treatment can be initiated and it will grow into an adult.

The **Nutrient Media Controls** (Fig. 15) monitor the composition of the media the embryo is growing in. *These controls are only available on the Advanced Level.* The levels of each nutrient will fluctuate as time elapses. Each nutrient must be maintained between the two arrows on its scale. Failure to do so will result in metabolic imbalances, mutations, or death.

To adjust the nutrient level use the Nutrient Control buttons to the left of each scale. The nutrient amount will gradually conform to the desired setpoint. *These controls are only used in the Advanced level.*

To change the pH level use the **Acid** and **Base** buttons below the **pH Level** monitor (Fig. 16). If the pH level is less than 7.0, the medium is Acidic; if the level is greater than 7.0, the medium is Alkaline. The pH level should always be kept in the midrange area. *This control is only used in the Advanced Level.*

The **Cell Division** button (Fig. 17, next page) is used to check the rate of cell division. The embryo window will display a cell in the process of division. It will also show you whether the division is Normal, Fast, or Slow. When the division rate is Fast or Slow, one or more of the nutrients will be out of balance.

To see the effects of various environmental factors on gene growth and mutation, see **Appendix A**.

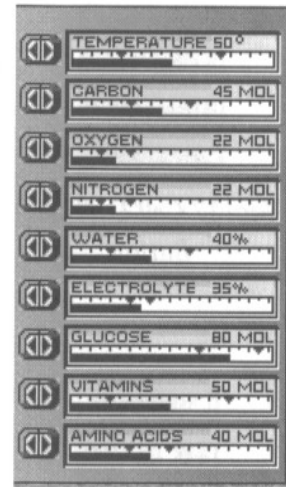


Fig. 15 Nutrient Media Controls with buttons

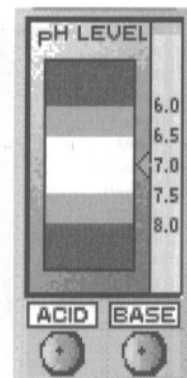


Fig. 16 pH Level

# G-NETIX

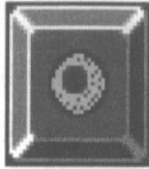


Fig. 17 Cell Division Button

## Fixing Mutated Cells

To repair a mutant cell, click the mouse to position the cross hair over the cell. When a mutant cell is selected, the body section it is part of will be shown in the lower left section of the display. You will use this body part to run a protein analysis.



Fig. 18 Protein Analysis Button

To enter the **Protein Analysis Mode** press the Protein Analysis button (Fig. 18). In the early stage of development (before Day 28) the Embryo Display Window will show a stylized embryo on the right and a list of proteins, which determine the formation of a particular life form, on the left (Fig. 19). In the late stage (after Day 28) the display window will show a human figure, with various organs inside, along with a list of

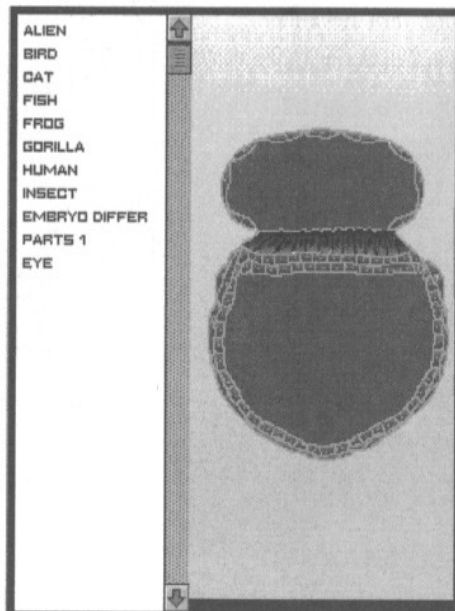


Fig. 19 Early Protein Analysis Display

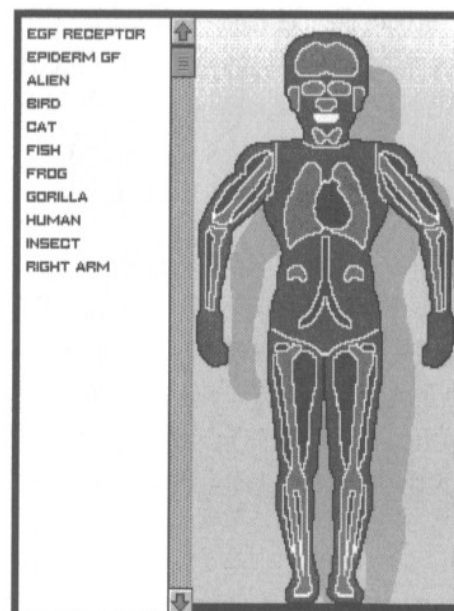


Fig. 20 Late Protein Analysis Display

proteins (Fig. 20). For a more detailed look at the body parts associated with this Late Stage figure, see **Appendix B**. In the early stage, click on one of three cell layers to display a list of proteins being produced. If a protein is present but dysfunctional, it will have a "•" before it in the list. If a protein is present in below normal quantities, it will have a "-" before it. If a protein is present in above normal quantities, it will have a "+" before it. In the late stage, click on a body part to show the protein list.

Cross check this list with the correct protein list in **Appendix C** to determine which proteins are not being produced as well as incorrect proteins which are being formed.

- If the protein appears in the embryo, but not in the Appendix C, the gene which makes that protein has mutated.

- If a protein does not appear in the embryo, but appears in Appendix C, it could be one of two things:

- 1) that gene has mutated
- 2) that gene is fine, but another gene which produces a protein required for synthesizing the first gene has mutated. Refer to the **Protein Dependency List** (see separate sheet).

Look these proteins up on the **Chromosome Map** which appears on the other side of the Protein Dependency List to determine which chromosome has mutated.

At this point, it might be helpful for you to familiarize yourself with the various genes by referring to the **Gene Description List** in **Appendix D**.

# G-NETIX

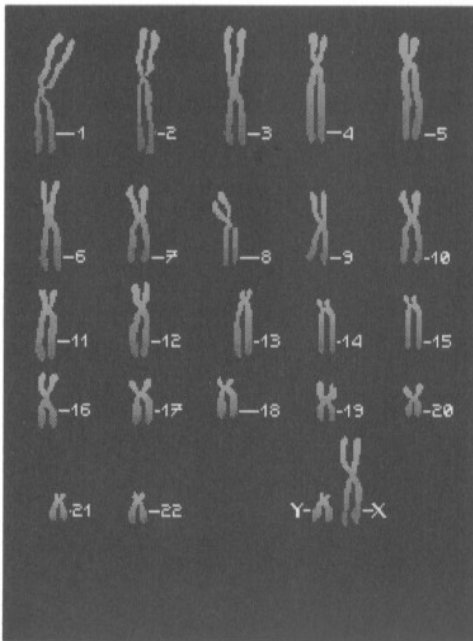


Fig. 21 Chromosome Button

Once the protein analysis is completed, the **Chromosome** button (Fig. 21) is used to start the gene editing process. Before attempting this, a mutated gene should be selected by clicking with the cross hair in the embryo display.

To return to the embryo mode, click on this button a second time.

The Embryo Display Window will show the chromosomes in the cell (Fig. 22). Click to select the desired chromosome. You will determine which chromosome to select by referring to the body part of the mutated cell, the protein analysis of that body part, and the Chromosome Map.



Double click on the selected chromosome to enter the chromosome section mode. In this mode you select which part of the chromosome you want to alter. Determine which section to select by referring to the Chromosome Map (see separate sheet). *Note: The entire chromosome is always available to you in the Gene Sequencer. The Chromosome section mode allows you to begin editing a chromosome at a place other than the start of the chromosome.*

Double click on the desired chromosome section or push the **Gene Edit** button (Fig. 23) to enter the gene edit mode.

Fig. 22 Gene Chart

## The Gene Sequencer

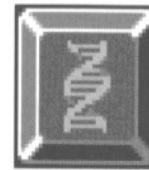


Fig. 23 Gene Edit Button

The lower half of the **Gene Sequencer** (Fig. 24) displays the gene currently being edited. The upper half of the window allows you to create a Gene Library by saving critical sequences. Click in either the upper or lower half to select it.

The gene proper is displayed as a sequence of nucleotides across the center of the double helix. It acts much like a

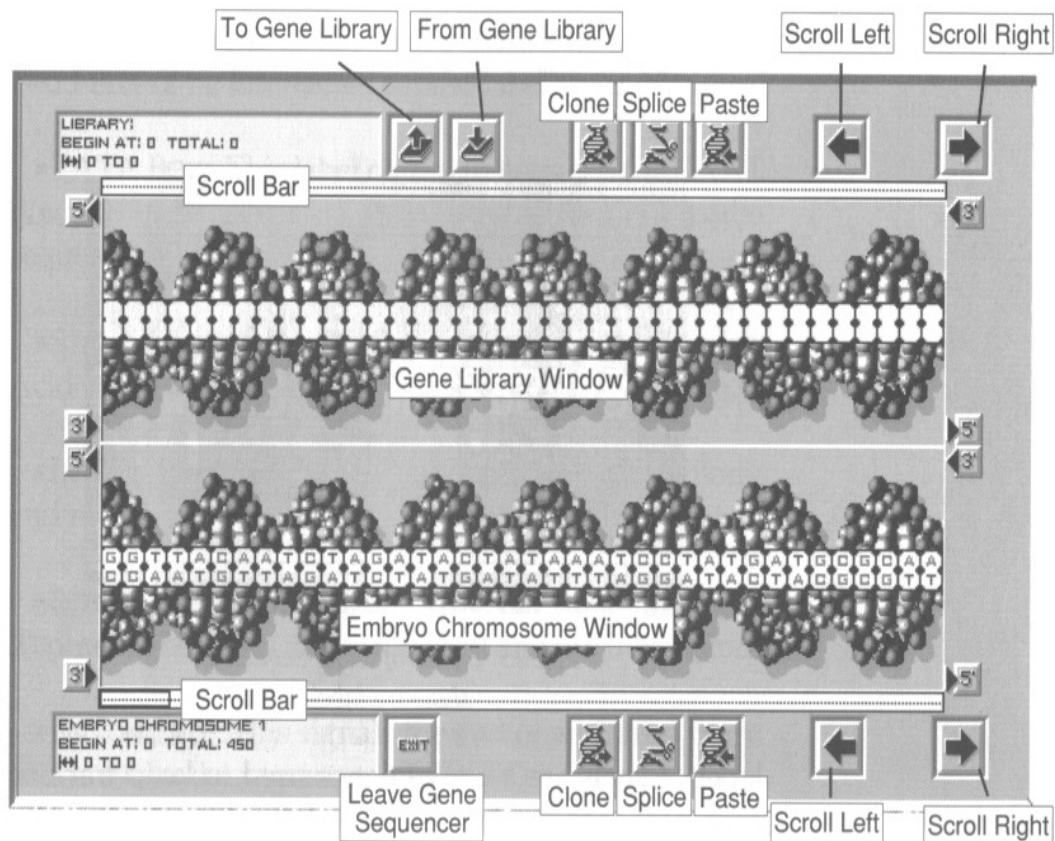


Fig. 24 The Gene Sequencer

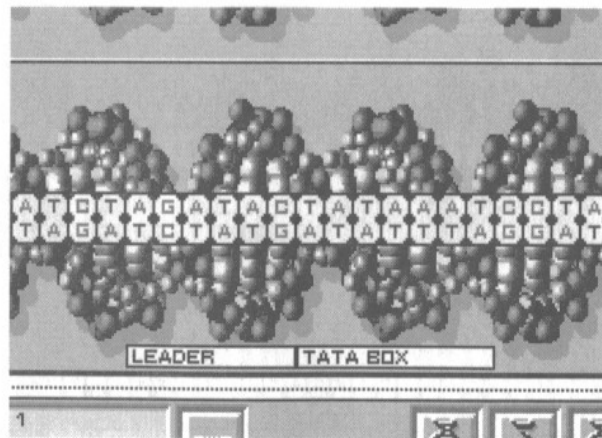
# G-NETIX

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word processor. Note: When reading the nucleotide sequence, read the top line, not the bottom. In Fig. 25, the sequence begins with ATC, not TAG.

Click on a nucleotide to position the insertion point. Click-drag to create a selection of nucleotides. Shift-click to create a selection from the current insertion point to the last click point. Click-hold on the **Scroll Left** and **Scroll Right** buttons to view different parts of the chromosome. You can also use the scroll bar for this purpose.

Labels may be created below the double helix (Fig. 25). In Fig. 25 there is a "leader" label and a "TATA box"



*Fig. 25 Detail of Gene Sequencer showing labels*

label. Labels are a convenience used to keep track of each part of the chromosome or to interpret the amino acid sequence encoded therein. They are created by click-dragging in the area below the double helix. A label may be resized by click-dragging the left or right

edge. Click-hold within the label area to produce a pop-up menu listing the various label types (Fig. 26). Selections include:

- **AMINO ACIDS:** This label can be any sequence and will translate groups of three nucleotide codons into the corresponding amino acids. This label generally starts immediately after the START CODON and ends at a STOP CODON.

- **CAAT BOX:** This signals the start of a gene in a chromosome and must be the sequence CCAATGTTAGA. If the sequence is incorrect, you will not be allowed to set the label to CAAT Box.

- **TATA BOX:** This label comes in between the CAAT Box and Start Codon. It can only be applied to the sequence ATATTTA.

- **START CODON:** This signals the start of the Amino Acid sequence and must be applied to a TAC string.

- **INTRON START:** This signals the start of an Intron Body and must be the sequence CACTCA.

- **INTRON BODY:** In real life this string is of no significance. It comes in between the Intron Start and the Intron End.

- **INTRON END:** This signals the end of an Intron Body and must be the sequence ATTTGTC.

- **STOP CODON:** This signals the end of an Amino Acid sequence. It must be the sequence ATT, ATC, or ACT.

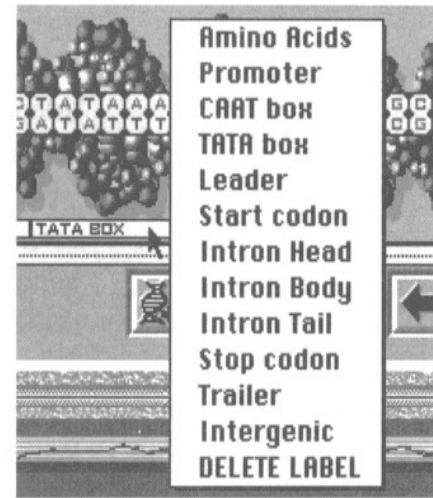


Fig. 26 Label Pop-up Menu

# G-NETIX

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- **TERMINATION SEQUENCE:** This comes in between the Stop Codon and Intergenic region and for labeling purposes can be any sequence. In real life, the termination sequence must be a complementary palindrome.

- **INTERGENIC:** This is a string that comes in between two genes and can be any sequence. This comes in between the Trailer and the CAAT Box of the next gene in line.

- **DELETE LABEL:** This will remove a label from the Gene Edit Window.

The Amino Acid, CAAT Box, TATA Box, Start Codon, Intron Start, Intron End, and Stop Codon labels will automatically resize themselves to the proper length. The left edge must start at the proper place.

The **Scroll Bar** displays the current position in the gene and may be used to move the section being displayed by clicking before or after the Scroll Thumb or by dragging the Thumb.

The **Scroll Left** and **Scroll Right** buttons scroll the chromosome like the Scroll Bar.

The **Title Box** in the lower left corner of the Gene Edit Window displays the chromosome ID number, the body part the chromosome belongs to (or the gene library title), the first nucleotide number visible, the total number of nucleotides, and the start and finish positions of the selection (if shown).

The **Splice**, **Clone**, and **Paste** buttons (Fig. 27) function the same as in any Macintosh word processing program.

# User Guide

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They work with the current selection and insertion point. The Clone button copies the current selection into the clipboard. The Splice button copies the selection to the clipboard, then deletes the display. The Paste button inserts a clone of the clipboard into the chromosome at the insertion point. It is possible to Splice or Clone from the Embryo gene and Paste into the Gene Library gene or vice versa. You may also Splice, Clone, or Paste from the **Edit Menu**.

The **Tab** key toggles between the Embryo Chromosome Window and the Gene Library Window. You can also click on a window to select it. There is also a **Find Sequence** function which allows the user to search the DNA for a given sequence. To use:

- 1) Select **Find Sequence** from the Edit Menu.
- 2) When window appears, type in sequence you wish to search for (using only A, T, C, and G).
- 3) Press **Find** button. The Gene Edit Window will scroll to that sequence if it occurs in that DNA. The **Find** will start searching at the current insertion point.

The **To Gene Library** and **From Gene Library** buttons (Fig. 28) work only in the Gene Library Window. **To Gene Library** will save the sequence currently in the Gene Library Window into the Gene Library. When saving, you will be asked to name the sequence. Selecting **From Gene Library** will display a list of saved Gene Library entries. You may load a DNA sequence into the Gene Library Window by double clicking on its name. The Gene Library allows you to save healthy gene sequences for future use.



Fig. 27 Splice, Clone, & Paste Buttons

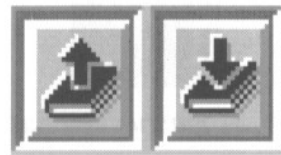


Fig. 28 To Gene Library & From Gene Library Buttons

# G-NETIX

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Fig. 29 Microscope Button

You will use labels in the Embryo Chromosome Window to help you locate the start of a defective gene's amino acid sequence, find its flaw and then repair it. To find the start of the next amino acid sequence, do a **Find** for the next TATA box (ATATTTA), then a **Find** for the Start codon (TAC). Refer to the **mRNA Sequence List** in **Appendix E**. To leave the Gene Edit Window press the **Exit** button.

## Combating Infections

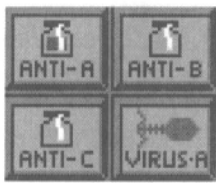


Fig. 30 Antibiotics Buttons

Bacterial infections can kill embryos. When infections occur, you must first identify the type of bacteria, then determine the correct antibiotic and dose to combat the illness.

You will be warned when the infection initially occurs. Bacteria appear as a cloud of black dots over the embryo. The cloud will thicken as time goes by. If not treated these infections will eventually kill the embryo.

In order to diagnose the infection, press the **Microscope** button (Fig. 29) to enter the Microscope Mode. The Embryo Display Window will show a microscopic view of a bacterial sample from the nutrient. The bacteria will have been treated with the standard Gram stain. Match this sample with the bacteria samples shown in **Appendix F** to determine the correct antibiotic treatment.



Fig. 31 Embryo Test Button

Once the infection is diagnosed, the **Antibiotics** buttons (Fig. 30) are used to introduce appropriate antibiotics into the nutrient media. It is important to use the correct antibiotic for each type of infection. Failure to do so can make the disease worse.

To inject the culture medium with antibiotic press the proper antibiotic button. Release the button only after the entire embryo display is filled. Be careful. Holding down the button too long will result in an overdose, causing mutations or death. Not holding the button down long enough will fail to eliminate the bacteria. This could also result in death.

## Testing the Embryo

To test the viability of the embryo, push the **Embryo Test** Button (Fig. 31). A test control panel will descend to cover the left half of the screen (Fig. 32). Viability of the embryo can be tested anytime up to the 84th day.

The **Electrical Stimulation** button tests the embryo's ability to twitch and move. If the embryo does not respond, its nervous system may be absent or non-functional. In addition, the embryo will not move if the level of electrolyte is out of the safe zone (not applicable in Basic Level).

The **Brain** button detects the presence of an active brain (assuming the embryo has developed to a point where it normally would have a brain). EEG stands for Electro-Encephalogram, an instrument which measures brain activity. If a brain is present, an EEG trace will appear in the **EEG Display**. Lack of a wave indicates no functional brain or nervous system.

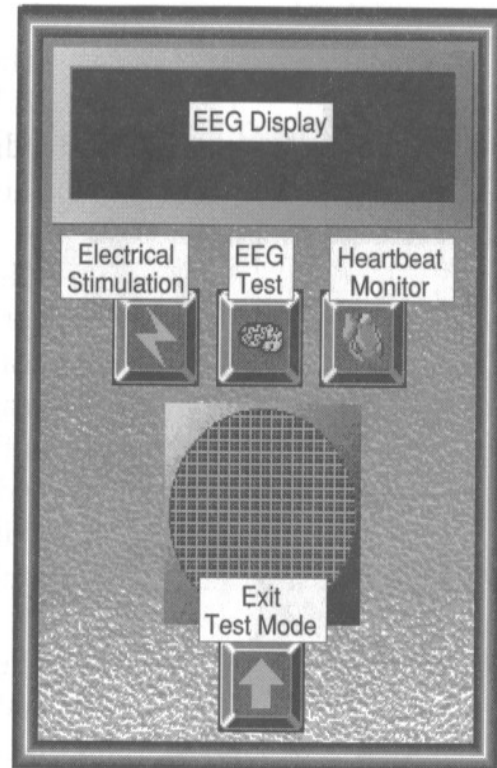


Fig. 32 Embryo Test Control Panel

# G-NETIX

The **Heartbeat Monitor** button detects the presence of an active heart (if the embryo has begun to develop a heart). If a heart is present, a heartbeat will be heard. No sound indicates the absence of a heart or an absent or malfunctioning central nervous system.

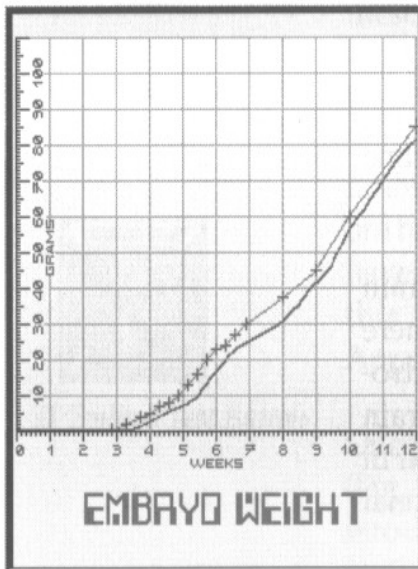
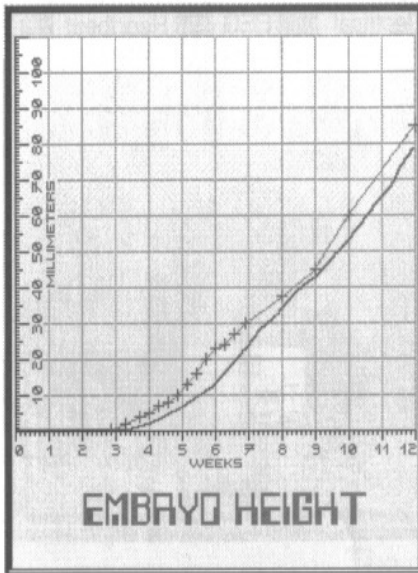


Fig. 33 Height & Weight Charts

Alien hearts have higher pitched sounds than normal human hearts. Cat, frog, fish, and bird hearts beat faster than a human heart. A gorilla heart rate and sounds are identical to a human's, but are louder. Insect hearts have a higher pitch and a faster beat rate than human hearts. The **Exit Test Mode** button will return you to the Embryo Mode.

The **Embryo Menu** will allow you to inspect the embryo's height and weight charts (Fig. 33). The height chart shows the embryo's height in millimeters (measured from rump to crown) along the left scale, and the age of the embryo in weeks along the bottom. The weight chart has the embryo's weight in grams along the left scale, and the age of the embryo in weeks along the bottom. On both charts, the green line represents the development of a healthy embryo. The red line represents the actual development. If the red line strays from the green one, there is a developmental mutation in the embryo.

The Embryo Menu will also allow you to abort the embryo and begin again with a new one.

## Adult Tests

When the embryo reaches the 12th week of development (Day 84), control will be taken away from you and the embryo will be force-grown to its adult form. In the **Basic Level**, you will be presented with the adult creature. Upon clicking the control panel, you will be returned to the Embryo Mode and a list of mutations will be displayed. You may double-click on this list to make it disappear and start a new embryo development.

In the **Advanced Level** you will be returned to the control room to administer tests to the adult creature to determine whether any mutations are present. The **Diagnostics Window** (Fig. 34) will lower on the right side of your screen. *These tests are available to you in the Advanced Level only.*

The Diagnostics Window is used to select the test(s) you wish to perform. When each test is completed, you will be returned here. When you have done all the tests to your satisfaction, push the **Exit** button. Do not press it before you are completely finished as you will be unable to return to the Diagnostics Window. After you have pushed the Exit button, you may click on the control panel to begin again with a new embryo.

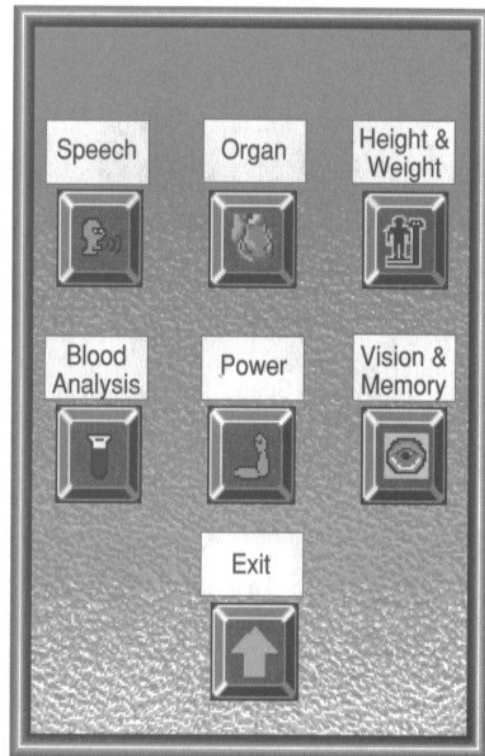


Fig. 34 Diagnostics Window

# G-NETIX

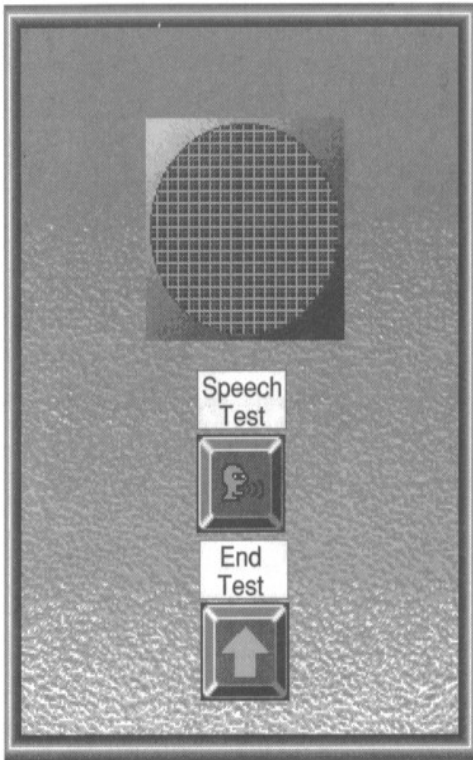


Fig. 35 Speech Test

## Speech

Push the **Speech Test** button (Fig. 35) to hear the creature speak. The creature will make no sound if it has no mouth. It will make no sound if the brain is non-functional. If the mouth is human, the creature will say "Hello." Otherwise, it will make a sound appropriate to its species (twittering for bird, croaking for frog, etc.).

## Organ

Pressing the **Brain** button activates the EEG display (Fig. 36). No wave in the display indicates lack of a functional brain or nervous system.

Pressing the **Heart** button activates the heartbeat speaker. No sound indicates the absence of a heart or an absent or malfunctioning central nervous system. The heartbeat will be slower if the temperature is low or the level of thyroid hormone in the blood stream is low (indicated by *-thyroid hormone* in the Protein Analysis). The heartbeat will be faster if the temperature is high or the level of thyroid hormone is elevated (indicated by *+thyroid hormone*).

Alien hearts have a higher pitched sound than human hearts; cat, frog, fish, and bird hearts beat faster than human hearts; gorilla hearts are identical to human hearts but are much louder; and insect hearts have a

higher pitch and a faster beat rate than human hearts.

Pressing the **Lung Test** button activates the lung sound speaker. No sound indicates lack of a functional lung or nervous system.

## Height & Weight

Pressing the **Height & Weight** button (Fig. 37) on the Diagnostics Window will activate the height and weight window. Wait for the numbers to stop changing to read the creature's height and weight.

## Blood Analysis

Pressing the **Blood Analysis** button (Fig. 38, next page) on the Diagnostics Window will give you a list of proteins in the creature's blood stream. Examine the list carefully for proteins that should not be present or for missing proteins and compare with the list of Blood Stream Proteins in Appendix C. Such mutations will be in one of the torso's chromosomes.

## Power

This tests the strength of various limbs. Use the **Increase Resistance** and **Decrease Resistance** buttons (Fig. 39, next page) to set the pounds of pressure the limbs must overcome in order to move (a normal human can move 200 lbs.). Then press the appropriate stimulation button

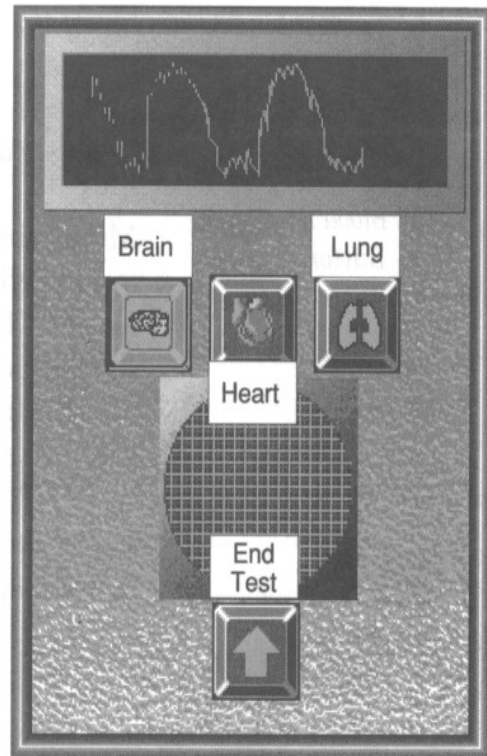


Fig. 36 Organ Test Monitor



Fig. 37 Height & Weight Button

# G-NETIX



Fig. 38 Blood Analysis Button

to see if the limb can move at that level of resistance. A given limb will be absent or stunted due to various mutations. Such mutated limbs will not move even if the resistance is zero.

Mutations that effect the limb's muscular or nervous system will cause the limb to be weak or unable to move at all. Other mutations will make the bones brittle. Brittle bones will snap if subjected to too much resistance. A broken limb will not respond to further stimulus.

## Vision and Memory

These tests examine the sight and memory of the adult.

To test vision and memory fill the Test Pattern Display (Fig. 40) with a series of circles, triangles, and/or squares by pressing those buttons. The **Erase Pattern** button will clear the display.

If the man's mouth has mutated into a different species, these tests are worthless. He cannot tell you what sequence he sees if all he can say is "chirp-chirp." He will not respond at all if he has no brain.

The Vision test tests the subject's visual acuity. The man will repeat the sequence correctly, but haltingly, if he has a bad set of lenses. He will repeat the sequence incorrectly if he has more serious eye problems.

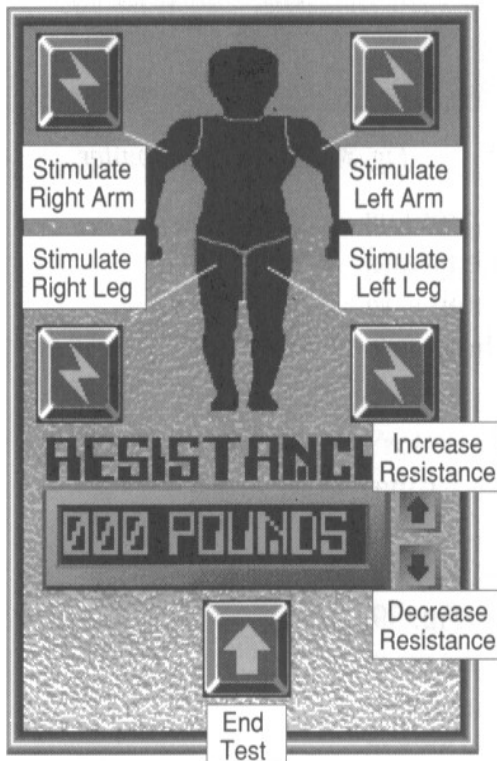


Fig. 39 Power Test

# User Guide

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The Night Vision test tests the subject's vision under subdued lighting. If the human's Night Vision gene is mutated, he will repeat an incorrect sequence during the Night Vision test.

The Memory test tests the subject's short term memory of what he has learned. He will repeat the sequence incorrectly in this test if his head has a mutated Memory gene.

The Color Vision test does not require a pattern display. If the man has normal color vision, he will reply "69" to the color vision test. If the eye's Color Blindness gene is mutated, he will reply "21." This number will appear to anyone suffering from red-green color blindness.

Pressing the **Exit** button will return you to the Diagnostics Window.

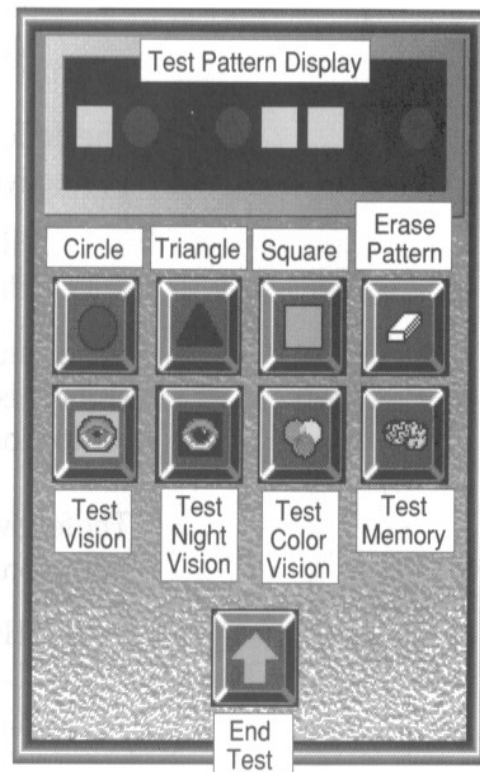


Fig. 40 Vision & Memory Test

## Appendix A

### Environmental Factors

The following environmental factors cause the embryo to become sluggish (to twitch less frequently):

- Low temperature
- Out of range (too high or low) oxygen, carbon, nitrogen, water, electrolytes, glucose, vitamins
- Out of range pH
- Absent steroid hormone
- No thyroid protein
- No thyroid receptor protein.

The following things cause the embryo to become overactive (to twitch more frequently than usual):

- High temperature
- Elevated thyroid protein level.

Either sluggishness or overactivity indicate that the embryo is in distress. If it is allowed to remain in distress for too long, it will die.

The following environmental factors cause the following mutations to the homeotic gene:

- High oxygen => gorilla
- Low oxygen => insect
- Low nitrogen => cat

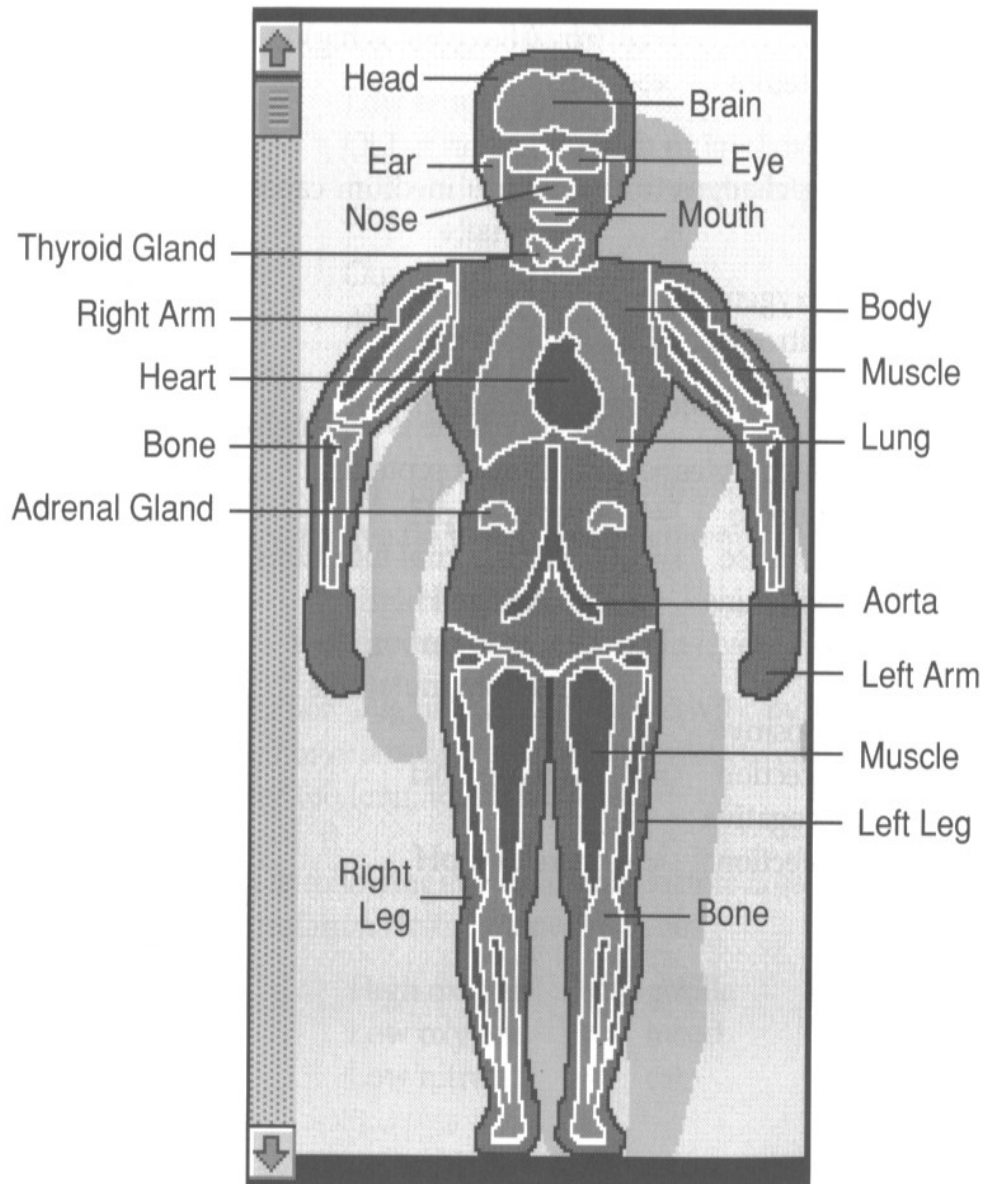
High water => fish (if oxygen is low)  
=> frog (if oxygen is high)  
Low vitamin => bird

The following changes to the culture medium cause these effects:

High oxygen => increased pH  
High nitrogen => increased pH  
High water => decreased pH  
(if electrolyte is also high)  
Low electrolytes => no thyroid protein  
Low glucose => decreased pH  
High glucose => bacterial/viral infections  
High vitamins => increased pH  
Low pH => increased carbon level  
& random mutations  
gram positive  
rod infection => decreased pH  
gram negative  
rod infection => increased pH

## Appendix B

Late Stage Diagram of Body Parts



## Appendix C

### Protein Analysis List

This list shows what a healthy embryo should display in Protein Analysis mode.

- **Early Stage, upper cell layer**

**Basic Mode**

alien  
bird  
cat  
embryo differentiation  
  
eye  
fish  
frog  
gorilla  
homeotic [h]  
human  
insect  
parts

**Advanced Mode**

alien  
bird  
cat  
embryo  
differentiation  
  
eye  
fish  
frog  
gorilla  
homeotic [h]  
human  
insect  
parts

- **Early Stage, middle cell layer**

**Basic Mode**

left arm  
left leg  
right arm  
right leg

**Advanced Mode**

left arm  
left leg  
right arm  
right leg  
thyroid2 synthesis  
thyroid gland  
thyroid receptor

# G-NETIX

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- **Early Stage, middle cell layer (continued)**

- Basic Mode**

- Advanced Mode**

- thyroid stimulation
  - thyroid synthesis

- **Early Stage, lower cell layer**

- Basic Mode**

- [nothing]

- Advanced Mode**

- [nothing]

- **Adrenal Gland**

- Basic Mode**

- steroid hormone 2

- Advanced Mode**

- steroid hormone 2
  - steroid b
  - steroid gland
  - steroid stim

- **Blood Stream**

- Basic Mode**

- steroid hormone 2

- thyroid hormone

- Advanced Mode**

- antibody
  - endonuclease
  - hormone release factor
  - interferon
  - steroid b
  - steroid hormone 2
  - steroid receptor
  - steroid stimulation
  - temperature sensitivity
  - thyroid hormone
  - thyroid receptor
  - thyroid stimulation
  - thyroid synthesis

- **Blood Stream (continued)**

- Basic Mode**

- Advanced Mode**

- toxin binding  
protein

- **Brain**

- Basic Mode**

- [nothing]

- Advanced Mode**

- brain  
acetylcholine  
excitatory enzyme a  
excitatory enzyme b  
gaba  
hormone releasing  
protein  
inhibitory enzyme a  
inhibitory enzyme b  
nerve  
nerve growth  
factor receptor

- **Bones (right arm, left arm, right leg, left leg)**

- Basic Mode**

- [nothing]

- Advanced Mode**

- collagen I  
collagen II  
osteoprotein

- **Ear**

- Basic Mode**

- alien  
bird  
cat  
ear

- Advanced Mode**

- alien  
bird  
cat  
ear  
ear nerve

# G-NETIX

---

## •Ear (continued)

### Basic Mode

eg factor receptor [h]

eg factor

fish

frog

gorilla

human

insect

### Advanced Mode

eg factor

receptor [h]

eg factor

fish

frog

gorilla

human

insect

nerve growth

factor

## •Eye

### Basic Mode

alien

bird

cat

eg factor receptor [h]

eg factor

eye

fish

frog

gorilla

human

insect

### Advanced Mode

alien

bird

cat

crystallin

eg factor receptor [h]

eg factor

eye

fish

frog

gorilla

human

insect

nerve growth factor

night vision

optic nerve

## •Head

### Basic Mode

alien  
cat  
eg factor receptor [h]  
eg factor  
fish  
frog  
gorilla  
head  
human  
insect

### Advanced Mode

alien  
cat  
eg factor receptor [h]  
eg factor  
fish  
frog  
gorilla  
head  
human  
insect

## •Heart

### Basic Mode

[nothing]

### Advanced Mode

acetylcholine  
acetylcholine  
  esterase  
actin 2  
heart  
heart nerve  
myosin 2  
nerve growth factor  
norepinephrine

## •Left Arm

### Basic Mode

alien  
bird  
cat  
eg factor receptor [h]  
eg factor

### Advanced Mode

alien  
bird  
cat  
eg factor receptor [h]  
eg factor  
excitatory enzyme a  
excitatory enzyme b

# G-NETIX

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## •Left Arm (continued)

### Basic Mode

fish  
frog  
gorilla  
human

insect  
left arm

### Advanced Mode

fish  
frog  
gorilla  
human  
inhibitory enzyme a  
inhibitory enzyme b  
insect  
left arm

## •Left Leg

### Basic Mode

alien  
bird  
cat  
eg factor receptor [h]  
eg factor

fish  
frog  
gorilla  
human

insect  
left leg

### Advanced Mode

alien  
bird  
cat  
eg factor receptor [h]  
eg factor  
excitatory enzyme a  
excitatory enzyme b  
fish  
frog  
gorilla  
human  
inhibitory enzyme a  
inhibitory enzyme b  
insect  
left leg

## •Lung

### Basic Mode

[nothing]

### Advanced Mode

lung  
lung nerve  
organ

- **Mouth**

- Basic Mode**

- alien
  - bird
  - cat
  - eg factor receptor [h]
  - eg factor
  - fish
  - frog
  - gorilla
  - human
  - insect
  - mouth

- Advanced Mode**

- alien
  - bird
  - cat
  - eg factor receptor [h]
  - eg factor
  - fish
  - frog
  - gorilla
  - human
  - insect
  - mouth

- **Muscle (right arm, left arm, right leg, left leg)**

- Basic Mode**

- [nothing]

- Advanced Mode**

- acetylcholine
  - acetylcholine  
esterase
  - actin 1
  - muscle nerve
  - myo
  - myosin 1
  - troponin

- **Nose**

- Basic Mode**

- alien
  - bird
  - cat
  - eg factor receptor [h]
  - eg factor
  - fish
  - frog

- Advanced Mode**

- alien
  - bird
  - cat
  - eg factor receptor [h]
  - eg factor
  - fish
  - frog

# G-NETIX

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## •Nose (continued)

### Basic Mode

gorilla  
human  
insect  
nose

### Advanced Mode

gorilla  
human  
insect  
nose

## •Right Arm

### Basic Mode

alien  
bird  
cat  
eg factor receptor [h]  
eg factor  
  
fish  
frog  
gorilla  
human  
  
insect  
right arm

### Advanced Mode

alien  
bird  
cat  
eg factor receptor [h]  
eg factor  
excitatory enzyme a  
excitatory enzyme b  
fish  
frog  
gorilla  
human  
inhibitory enzyme a  
inhibitory enzyme b  
insect  
right arm

## •Right Leg

### Basic Mode

alien  
bird  
cat  
eg factor receptor [h]  
eg factor

### Advanced Mode

alien  
bird  
cat  
eg factor receptor [h]  
eg factor  
excitatory enzyme a  
excitatory enzyme b

## •Right Leg (continued)

### Basic Mode

fish  
frog  
gorilla  
human

insect  
right leg

### Advanced Mode

fish  
frog  
gorilla  
human  
inhibitory enzyme a  
inhibitory enzyme b  
insect  
right leg

## •Thyroid Gland

### Basic Mode

thyroid hormone

### Advanced Mode

thyroid 1 synthesis  
thyroid 2 synthesis  
thyroid gland  
thyroid hormone  
thyroid stimulation

## •Torso

### Basic Mode

alien  
bird  
cat

eg factor receptor [h]  
eg factor  
embryo differentiation

### Advanced Mode

acetylcholine  
acetylcholine  
receptor  
alien  
bird  
cat  
central nervous  
system  
eg factor receptor [h]  
eg factor  
embryo  
differentiation  
excitory enzyme a

# G-NETIX

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## •Torso (continued)

### Basic Mode

fish  
frog  
gorilla  
homeotic [h]  
human

insect

methylase

parts

torso

### Advanced Mode

excitatory enzyme b  
female hormone

fish

frog

gorilla

homeotic [h]

human

inhibit enzyme a

inhibit enzyme b

insect

late stage

male hormone

memory

organ

parts

radiation repair

tRNA - tyrosine

torso

## Appendix D

### Gene Description List

The following is the description of the genes in the chromosome map. There are 23 pairs of chromosomes in human beings. The chromosome map only shows the dominant allele of the pair. Assume the other part of the pair is recessive. Notice there are 24 chromosomes shown in the chart instead of 23 since both the *y* chromosome and *x* chromosome are shown.

#### Chromosome 1

**Gene 1: acetylcholine receptor**

**Gene 2: thyroid stimulation**

**Gene 3: nerve growth factor**

**Gene 4: actin 1**

**Gene 5: embryonic differentiation**

**Acetylcholine receptor gene (AcR):** The acetylcholine receptor is a protein receptor that binds acetylcholine. It is present on the surface of the cells of the body parts. The acetylcholine-receptor complex initiates reactions inside the cell. Mutation of acetylcholine receptor gene results in an inability to move the body parts which were contracted. The heart also becomes rapid.

**Thyroid stimulating gene:** The thyroid stimulating gene synthesizes thyroid stimulating hormone (TSH). Thyroid stimulating hormone (TSH) regulates the growth of the thyroid gland. It also regulates the synthesis of thyroid hormone by controlling the thyroid

# G-NETIX

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synthesizing genes operon. The Thyroid stimulating gene is regulated by hormone releasing protein. Mutation of this gene results in an absent thyroid gland and impaired production of thyroid hormone.

**Nerve growth factor gene:** Nerve growth factor genes cause the formation of Nerve growth Factor (NGF) which is released by the cells of the organs and limbs. Nerve growth factor combines with the nerve growth factor receptor (NGF\_RP), which are present at the nerve endings, and stimulates the growth of the nerves at the corresponding organ or limb. Mutation of nerve growth factor genes result in absent nerve growth.

**Actin1:** The actin1 gene forms the protein Actin1 which is present in the muscles. Actin1 and myosin1 act together to cause contraction of the muscles. Actin1, myosin1 and contrasin genes are regulated by the myo protein. The Troponin protein causes relaxation of the muscles. Mutation of actin1 genes result in impaired synthesis of actin1 protein and absent muscle contraction. Actin1 is not present in birds or gorillas.

**Embryonic differentiating Gene:** The embryonic differentiating gene controls the differentiation of early embryo into three layers: ectoderm, mesoderm and endoderm. The embryonic differentiating gene is expressed only at an early stage. Expression of the embryo differentiating gene in the later stage of development of the embryo is suppressed by the regulatory proteins released from Part genes and Organ genes. Mutation of embryonic differentiating gene is fatal. It results in the failure of embryo development beyond the early stage.

## Chromosome 2

**Gene 1: antibody (1st half)**

**Gene 2: optic nerve**

**Gene 3: crystallin (1st half)**

**Gene 4: brain**

**Antibody (first half):** Antibodies are proteins which protect the body against infections. An antibody (1st half) gene forms one half of the antibody. Mutation of the antibody (1st half) gene or the antibody (2nd half gene) results in impaired production of antibodies. The body is unable to fight any infection that occurs.

**Optic nerve:** The optic nerve gene causes the eye nerve to develop. This gene is regulated by the brain gene. Mutation of the optic nerve gene results in total blindness.

**Crystallin (first half):** Crystallin is the protein component of the eye's lens. It is produced by the crystallin gene. Mutation of the crystallin first half or second half gene results in impaired vision, but not total blindness.

**Brain:** The brain gene controls the development of the brain. It is regulated by the CNS gene. Mutation of the brain gene results in an absent brain. The embryo cannot survive without the brain.

## Chromosome 3

**Gene 1: thyroid receptor**

**Gene 2: gorilla**

**Gene 3: temperature sensitivity**

**Gene 4: nose**

# G-NETIX

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**Thyroid receptor:** The thyroid receptor is a protein that is present on the surface of cells. It combines with thyroid hormone. The thyroid hormone-receptor complex regulates the DNA inside the cell and controls the metabolism of the cell. Mutation of thyroid receptor prevents the formation of thyroid hormone-complex. The metabolism of the cell slows down since there is no thyroid to regulate the hormone.

**Gorilla:** The gorilla gene causes the specie to become a gorilla. This gene normally does not express itself. It is regulated by the homeotic gene and the epidermal growth factor gene.

**Temperature sensitivity:** The temperature sensitivity gene controls the growth of the embryo. It allows the embryo to grow only at a correct temperature. Mutation of temperature sensitivity gene causes the embryo to stop growing when the temperature varies from the optimum temperature range.

**Nose:** The nose gene controls the development of the embryo's nose.

## Chromosome 4

Gene 1: bird

Gene 2: epidermal growth factor

Gene 3: frog

Gene 4: lung nerve

Gene 5: ear nerve

Gene 6: endonuclease

Gene 7: acetylcholine esterase

**Bird:** The bird gene changes the species to a bird. It is not normally expressed. It is regulated by the homeotic gene and the epidermal growth factor receptor gene.

**Epidermal growth factor:** The epidermal growth factor is a polypeptide that stimulates the growth of cells in the organs. Mutation of the Epidermal growth factor gene results in absent or short limbs.

**Frog:** The frog gene changes the species into a frog. This gene is not normally expressed. It is regulated by the homeotic gene and the epidermal growth factor receptor gene.

**Lung nerve:** The lung nerve protein stimulates the production of the nerve which supplies the lungs. Mutation of the lung nerve gene results in an absent nerve to the lung.

**Ear nerve:** The ear nerve protein stimulates the production of nerve which supplies the ears. Mutation of this nerve gene results in an absent nerve to the ear and deafness.

**Endonuclease:** Endonuclease is an enzyme that destroys genes. However, endonuclease cannot destroy the gene if it is methylated. Endonuclease is the mechanism the embryo uses to defend against virus infections. If the endonuclease gene is mutated, the embryo cannot protect itself against viral infections.

**Acetylcholine esterase:** Acetylcholine esterase is an enzyme that destroys acetylcholine. If acetylcholine is not destroyed muscles will be unable to relax when

# G-NETIX

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stimulated. Mutation of acetylcholine esterase gene results in persistent acetylcholine.

## Chromosome 5

**Gene 1: torso**

**Gene 2: heart**

**Gene 3: steroid receptor**

**Gene 4: human**

**Torso:** The torso gene controls the development of the embryo body torso.

**Heart:** The Heart gene controls the development of the heart.

**Steroid receptor:** The steroid receptor is a protein which is located at the surface of the cell. It combines with steroid hormone and the hormone-receptor complex to regulate genes inside the cell. Mutation of the Steroid receptor gene results in an absent receptor protein.

**Human:** The human gene causes development of human species.

## Chromosome 6

**Gene 1: insect**

**Gene 2: radiation repair**

**Gene 3: excitory enzyme a**

**Gene 4: excitory enzyme b**

**Insect:** The insect gene causes the embryo to develop into an insect. It is regulated by the homeotic gene and the epidermal growth factor receptor gene.

**Radiation Repair:** The radiation repair gene repairs most of the damage done to the genes from radiation exposure. Mutation results in inability to repair the radiation damages.

**Excitatory enzyme A:** The excitatory enzymeA is one of the members of the operon. Mutation of the excitatory enzymeA gene results in absent synthesis of acetylcholine.

**Excitatory enzyme B:** The excitatory enzymeB is the other member of the operon. Mutation of excitatory enzymeB results in absent synthesis of acetylcholine.

## Chromosome 7

**Gene 1: homeotic 1**

**Gene 2: epidermal growth factor receptor**

**Gene 3: collagen I**

**Homeotic-1(HG-1):** A species gene that determines what species the embryo will develop into. In normal situations all the other species, except human, are suppressed. Depending upon the type of mutation, mutation of the Homeotic-1 gene causes the embryo to develop into another species.

**Epidermal growth factor receptor:** The epidermal growth factor receptor is a protein that is present in organ cells. It binds the epidermal growth factor and the complex controls the development of the parts of the embryo. Mutation of the epidermal growth factor results in body parts developing into different species types.

# G-NETIX

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**Collagen I:** Collagen I is a matrix substance that is present in different parts of the body. In bone, it gives strength and resilience. Collagen I is present only in humans. Mutation results in fragile bones.

## **Chromosome 8**

**Gene 1: parts (first half)**

**Gene 4: right leg**

**Parts:** The parts gene is a regulatory gene that controls the development of body part genes (head gene, torso gene, left arm gene, right arm gene, left leg gene, right leg gene, left ear gene, right ear gene, mouth gene, eye gene and ear gene). The parts gene synthesizes the regulatory protein -Parts protein. Mutation of this gene results in impaired development of body parts.

**Right leg:** The right leg gene controls the development of right leg. This is a structural gene. Mutation results in impaired development of the right leg.

## **Chromosome 9**

**Gene 1: interferon**

**Gene 2: left leg**

**Interferon:** Interferon is a polypeptide that the embryo produces to fight against viral infections, particularly viral B infections. Mutation of the interferon gene results in impaired production of interferon.

**Left leg:** The left leg gene is a regulatory gene that controls the development of the embryo's left leg. Mutation results in impaired development of the left leg.

## Chromosome 10

**Gene 1: heart nerve**

**Gene 2: right arm**

**Gene 3: steroid synthesizing enzyme a**

**Gene 4: steroid synthesizing enzyme b**

**Gene 5: hormone releasing hormone**

**Heart nerve:** The heart nerve protein controls the growth of nerve supply to the heart. Mutation causes the nerve supply to stop growing and the heart to stop beating.

**Right arm:** The right arm gene is a regulatory gene that controls the development of the right arm. Mutation of this gene results in an impaired development of the right arm.

**Steroid synthesizing enzyme A:** Steroid synthesizing enzyme A (SSE-A) is a member of the multigene family. It is present only in the early stage embryo. It catalyzes steroid hormone1 from fat in the body. It is stimulated by the steroid stimulating hormone (SSH). Steroid hormone1 regulates the antibody gene. Steroid hormone1 also regulates the growth of the embryo. Mutation of the Steroid Synthesizing enzyme A results in the absence of steroid hormone1 or the nonfunctioning of steroid hormone1, depending upon the type of mutation.

**Steroid Synthesizing enzyme A:** Steroid synthesizing enzyme B (SSE-B) is a member of the multigene family. It is present only in the late stage embryo. The steroid synthesizing gene is not expressed at the early stage of embryo development. It catalyzes steroid hormone2 from fat in the body. It is stimulated by the steroid

# G-NETIX

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stimulating hormone (SSH). Steroid hormone<sub>2</sub> regulates the antibody gene. It also regulates the growth of the embryo. Mutation of the Steroid Synthesizing enzyme B results in the absence or nonfunctioning of steroid hormone<sub>2</sub>, depending upon the type of mutation.

**Hormone releasing hormone:** The hormone releasing gene is a regulatory gene that releases hormone releasing hormone (HrH). Hormone releasing hormone stimulates the synthesis and release of steroid stimulating hormone (SSH) and thyroid stimulating hormone (TSH). Mutation of the hormone releasing gene causes the absence of the steroid and thyroid glands.

## Chromosome 11

Gene 1: tRNA tyrosine

Gene 2: parts (second half)

Gene 3: Left arm

Gene 4: inhibitory enzyme a

Gene 5: inhibitory enzyme b

**tRNA tyrosine:** The tRNA<sup>tyrosine</sup> gene controls the synthesis of transfer RNA for tyrosine amino acid. It also synthesizes tyrosine. Mutation of tRNA<sup>tyrosine</sup> gene prevents the formation of the amino acid tyrosine. All the proteins and polypeptides that contain tyrosine are affected. This is a fatal mutation.

**Parts (second half):** The parts gene (both the first half and second half combined) is a regulatory gene that regulates the growth of body parts. Mutation of the parts gene results in no development of the body parts.

**Left arm:** The left arm gene is a regulatory gene that controls the development of left arm of the embryo.

Mutation of the left arm gene results in an absent or undeveloped left arm.

**Inhibitory protein enzyme A:** Inhibitory protein enzyme A is part of the operon that synthesizes GABA, a polypeptide that is present in the brain and nervous system. GABA is synthesized from carbon supplied in the culture medium by the enzymes. If carbon is deficient in the medium or if there is mutation in Inhibitory protein enzyme A, GABA is not formed. If GABA is absent the mutant is goes into spasm when stimulated and is unable to relax.

**Inhibitory protein enzyme B:** Inhibitory protein enzyme B is also part of the operon that synthesizes GABA. Mutation of Inhibitory protein enzyme B results in no formation of GABA.

## **Chromosome 12**

**Gene 1: Alien**

**Gene 2: memory**

**Gene 3: Late stage differentiation**

**Alien:** The alien protein is a regulatory protein which, when expressed, causes the embryo to change to alien. It is normally suppressed. It is regulated by the homeotic gene and the epidermal growth factor receptor gene.

**Memory:** If the memory gene mutates the mutant is unable to remember and repeat what he has read in the Memory Test.

# G-NETIX

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**Late stage differentiation:** The late stage differentiation gene is expressed when the embryo becomes 28 days old. Mutation is fatal.

## **Chromosome 13**

**Gene 1: cat**

**Gene 2: Myo protein**

**Gene 3: Myosin 2**

**Cat:** The cat gene is a regulatory gene. When it is expressed it changes the embryo into a cat. Normally it is suppressed. It is regulated by the homeotic gene and the epidermal growth factor receptor gene.

**Myo protein (Myo-P):** The myo gene is a regulatory gene that releases myo protein. Myo protein controls the actin1 gene, myosin1 gene, contrasins gene, and troponin gene which are muscle fibres genes. Mutation of this gene results in absent muscle fibre proteins. It is, in turn, controlled by the organ gene.

**Myosin2:** Myosin2 is one of the heart muscle proteins. Combination of Myosin2 and actin2 causes contraction of the heart. The heart can not contract if myosin2 or actin2 are absent.

## **Chromosome 14**

**Gene 1: mouth**

**Gene 2: fish**

**Gene 3: antibody (second half)**

**Gene 4: muscle nerve**

**Gene 5: lung**

**Mouth:** The mouth gene controls the development of the embryo's mouth. It is controlled by the parts gene.

**Fish:** The fish gene is a regulatory gene which, when expressed, changes the embryo into a fish. It is regulated by the homeotic gene and the epidermal growth factor receptor gene.

**Antibody (second half):** Antibody (second half) combines with antibody (first half) to become a complete antibody. Antibodies are needed to fight infections. Without antibodies the embryo is incapable of fighting any infection.

**Muscle nerve:** Muscle nerve stimulates the development of the nerve supply to the muscles. Mutation of this gene results in no nerve supply to the muscles. The muscle cannot contract or move.

**Lung:** The lung gene controls the development of the lungs. No lungs will develop if this gene is mutated.

## **Chromosome 15**

**Gene 1: actin2**

**Gene 2: contrasin**

**Gene 3: head**

**Actin2:** Actin2 is one of the muscle proteins present in the heart. Actin2 combines with myosin2 to contract the heart. The heart cannot contract if the actin2 is absent.

**Contrasin:** Contrasin is a muscle protein. It is expressed only in birds and gorillas. It is not present in other

# G-NETIX

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species. If it is present in other species, it interferes with other muscle protein functions and makes muscles flaccid and unresponsive to stimulus.

**Head:** The head gene is a regulatory protein that controls the development of the embryo's head.

## Chromosome 16

**Gene 1: nerve**

**Gene 2: night vision**

**Gene 3: norepinephrine synthesizing enzyme A**

**Gene 4: toxic binding**

**Nerve:** Nerve protein controls the development of the nervous system in muscles and organs, such as the heart. It also controls the nerve growth receptor gene. It is controlled by the CNS gene. Mutation of the nerve gene results in absent nerve proteins. There will be no development of the nerve supply to the heart and the muscles and no synthesis of nerve growth receptor protein.

**Night vision:** Mutation of the night vision gene results in night blindness.

**Norepinephrine synthesizing enzyme A:** This enzyme synthesizes norepinephrine. Norepinephrine counteracts the effect of acetylcholine. When the enzyme mutates norepinephrine is not synthesized. The heart beat slows down since there is no norepinephrine to counteracts the effect of acetylcholine.

**Toxin Binding Protein:** Toxic binding protein binds toxic substances and allows the embryo to destroy them. For example, toxic binding protein binds to antibiotics and destroys them. Translocation of the chromosome results in an ineffective toxic binding protein.

## Chromosome 17

**Gene 1: myosin 1**

**Gene 2: nerve growth factor receptor**

**Gene 3: growth hormone**

**Gene 4: osteoprotein**

**Myosin1:** Myosin1 is one of the muscle proteins present in muscle fibers. Together with actin1 it contracts muscle. Mutation of myosin1 results in flaccid and unresponsive muscles.

**Nerve growth factor receptor:** The nerve growth factor receptor is a protein present at the end of nerve fibers in the limbs and organs. It combines with the nerve growth factor. The nerve growth factor-receptor complex stimulates the growth of the nerve fibers in the organ. Nerve fibers will not grow if there is mutation of the receptor.

**Growth hormone:** Growth hormone stimulates the growth of the embryo. If the hormone is absent or dysfunctional embryos cannot grow. Even though the embryo is normal his height will be stunted.

**Osteoprotein:** Osteoprotein is a regulatory protein that stimulates bone formation and regulates the genes

# G-NETIX

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collagen I and collagen II (collagen III in alien). If the osteoprotein gene is mutated, no bone will be formed.

## **Chromosome 18:**

**Gene 1: methylase**

**Gene 3: ear**

**Gene 4: Shaker syndrome**

**Methylase:** Methylase is an enzyme that attaches a methyl group to the gene. This protects the gene from being destroyed by endonuclease. Virus genes do not have methylase and, therefore, can be destroyed by endonuclease. If the methylase gene is mutated the embryo cannot prevent genes from being destroyed by endonuclease.

**Ear:** The ear gene is a regulatory gene that controls the development of the embryo ear.

**Shaker:** Mutation of the shaker gene results in extreme shaking when the creature is stimulated.

## **Chromosome 19**

**Gene 1: Steroid gland**

**Gene 2: Steroid Stimulating Hormone**

**Gene 3: Organ**

**Steroid gland:** The steroid gland gene controls the development of the steroid gland. Without this gland the embryo cannot synthesize steroid hormone.

**Steroid stimulating hormone (SSH):** Steroid stimulating hormone regulates steroid gland development by controlling the steroid gland gene and

also acts of steroid synthesizing enzyme A (or B) gene. Absent steroid stimulating hormone results in an undeveloped steroid gland and absent steroid synthesizing enzymes.

**Organ:** The organ gene is a regulatory gene that acts on genes of organs (i.e. lung gene, osteoprotein gene, Central nervous system gene, heart gene, myo gene, thyroid gland gene, and steroid gland gene). Mutation of the organ gene results in absent organs and death.

## Chromosome 20

**Gene 1: Thyroid gland**

**Gene 2: Thyroid synthesizing enzyme1**

**Gene 3: Eye**

**Thyroid gland:** The thyroid gland synthesizes and produces the thyroid hormone. The gland is enlarged when there is excessive stimulation from the thyroid stimulating hormone (TSH). Mutation of the thyroid gland gene results in an impaired thyroid gland.

Thyroid hormone controls the body metabolism of the embryo. It also has a negative feedback mechanism. It regulates the synthesis of the thyroid stimulating hormone. Excessive thyroid hormone suppresses the thyroid stimulating hormone, while low thyroid hormone causes increase stimulation of the hormone. Excessive thyroid hormone results in excessive body metabolism of the embryo. The embryo becomes very active, rapidly using up the nutrients in the culture medium. Despite receiving food and nutrients, the embryo continues to lose weight. Underproduction of thyroid hormone slows down the body metabolism.

# G-NETIX

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The embryo becomes sluggish and cell activity and heart beat slow down.

**Thyroid synthesizing enzyme1:** Thyroid synthesizing enzyme1 is part of the operon that synthesizes thyroid hormone from iodine present in the culture medium. Mutation of thyroid synthesizing enzyme1 or thyroid synthesizing enzyme2 results in impaired thyroid hormone production.

**Eye:** The eye gene is a regulatory gene that controls the development of the embryo eye.

## Chromosome 21

**Gene 1: thyroid synthesizing enzyme 2**

**Gene 2: troponin**

**Gene 3: collagen II**

**Gene 4: crystallin (second half)**

**Thyroid synthesizing enzyme2:** Thyroid synthesizing enzyme 2 is part of the operon that synthesizes thyroid hormone from iodine. Mutation of thyroid synthesizing enzyme2 results in impaired production of thyroid hormone.

**Troponin:** Troponin is a muscle protein that relaxes the muscle after stimulation. If the troponin gene is mutated the muscle stays contracted.

**Collagen II:** Collagen is a substance that also provides strength and resiliency to the bone. If the collagen II gene is mutated it results in impaired production of collagen II and brittle bones.

**Crystallin (second half):** Crystallin is a protein present in the lens of the eye. The absence of crystallin causes poor vision.

## **Chromosome 22**

**Gene 1: Cat eye syndrome**

**Gene 2: Central nervous system**

**Cat eye syndrome:** Mutation of this gene causes the eyes of the embryo to look like those of a cat.

**Central nervous system (CNS):** The central nervous system gene is a regulatory gene that controls the development of the brain and nervous system. Naturally, the embryo cannot survive if the CNS gene mutates.

## **Chromosome Y**

**gene 1: Male hormone**

**Male hormone:** Male hormone makes the embryo have male characteristics. Mutation of this hormone makes the chromosome X become dominant and the adult sound female.

## **Chromosome X**

**Gene 1: collagen III**

**Gene 2: Color blindness**

**Gene 3: Female hormone**

**Collagen III:** Collagen III is normally expressed only in aliens. If collagen III mutates, alien bone strength diminishes. If the collagen III is expressed in human or other species the bone strength also diminishes.

# G-NETIX

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**Color blindness:** Mutation of this gene results in color blindness.

**Female hormone:** Female hormone produces feminine characteristics. Mutation of this gene has no effect on embryo development.

## Gene Notes:

An embryo is composed of the following parts: head, arms, legs, torso, eyes, nose, ears, and mouth. Each part has its own set of genes. A mutation of the nose gene in the left arm gene set is NOT going to affect the nose. But a mutation of the left arm gene in the left arm gene set will affect the left arm.

When a blinking mutated cell has the cross hair placed over it, the part (i.e., gene set) it is in will be displayed in the lower left hand corner. This will also determine which gene set you will be operating in when you enter **Edit Gene** mode. The default is Torso.

A part can be human, gorilla, cat, fish, frog, insect, bird, or alien. The species of the part is determined by the mutation in the body's homeotic gene. Exception: the species can be overridden in a given body part by a mutation in the part's epidermal growth factor receptor. Example: if the body's homeotic gene mutates to bird, all body parts will be bird. If the left arm's EGFR then mutates into insect, you will have a bird with an insect's left arm. If the homeotic or EGFR mutates to a certain species, and that species gene is mutated, the mutation will be fatal.

## Appendix E

### mRNA Sequence List

The mRNA created from a DNA strand's protein coding segment is *complementary* to the DNA. "C" will become "G," "G" will become "C," "A" will become "U," and "T" will become "A." Also, in the mRNA, all introns in the DNA will be removed.

Amino acid and mRNA sequences of the proteins:

#### **Acetylcholine Esterase**

LeuGlyArgLeuArgValSerLeuIleGlnArgValProArgLeu  
cuggggcggcuucggguuucacucauccagagaguaccacgcuaa

#### **Acetylcholine Receptor**

ArgAsnGluSerIleValProValSerHisIleProLysSerLeu  
cgcaaugaguccauaguuccguuuuccacauaccgaaaaguuaa

#### **Actin 1**

ThrGluLeuGlyThrSerTyrLysGlySerGlyAlaCysGlnAla  
acggaauugggcacgagcuauaagggcaguggcgccugccaagcg

#### **Actin 2**

IlePheGlyHisTyrSerArgArgGlyLeuIleGlnGlyPheThr  
auauucggucauuacagccgcaggggcuuaauccaaggguuuacu

#### **Alien**

LysThrSerThrProArgThrGluLeuAlaAlaValSerSerThr  
aaaaccucuacuccgaggacagaauuggccgcccugugucucaaca

#### **Antibody (first half)**

HisSerArgValGlnArgLys  
cauagucgaguccaaccgaaa

# G-NETIX

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## **Antibody (second half)**

IleProThrProGlyThrLeuAsp  
auaccaacuccaggacguuggac

## **Bird**

LeuLysSerTyrAsnGlyMetLeuGlyThrIleIleSerArgHis  
cugaaaaguacaacgggaugcuagguacgauuauuucgcggcac

## **Brain**

AsnHisAlaAspThrGluAlaPheSerTyrTyrPheCysValSer  
aaucaugcggacacggaggcguuuaguacuacuucugcguuagc

## **Cat Eye Syndrome**

SerMetSerLeuAlaTrpProAlaIleThrPhePheValValSer  
agcaugagcuuggccuggccagcaaucaguuuuucguaguaag

## **Cat**

IleArgLeuHisValPhePheGluPheArgLysArgAlaAsnAsn  
auacggcugcauguguuuuugaauuccggaaaagggcuaauaac

## **CN (Central Nervous) System**

ArgLeuSerPheSerAsnTyrSerHisThrThrArgTrpIleArg  
cgucucaguuucugaacuauagccacacgacucgguggauuaga

## **Collagen I**

ThrSerHisLeuLeuGlySerLeuTrpCysLeuSerIleIleArg  
acuagccaccuucuaaggauucuauggguguuuguccauuacaga

## **Collagen II**

ThrLeuArgLeuLeuAsnThrArgPheSerAspAlaLeuAsnPro  
acguuacgucucugaauacacggauucuccgacgccuuaaccca

## **Collagen III**

AlaAlaArgGlyGlyPheGlyTyrPheLeuLysAspSerArgLys  
gccgcucgaggaggauucgguuuuuccuacaggacagccguuag

## **Color Blindness**

SerLeuLysTyrValValPheArgProLeuValGluLysThrIle  
uccuugaaguacgugguguuccggcccuuaguggagaagacaaua

**Contrastin**

CysSerAsnLeuSerPhePheValSerThrProProCysSerArg  
ugcucuaaccuauucuucguaaguacucccccauguucuagg

**Crystallin (first half)**

AlaGlnTyrLysArgLeuArg  
gcucaauauaaacgccugcgc

**Crystallin (second half)**

ThrLeuGlyGlnAlaAsnSerAsp  
acauuaggccaagccaacucggau

**Ear**

AlaGlySerTyrGluHisLysCysAlaPheLeuLysSerSerTyr  
gcuggguccuauagagcacaagugugcuuuuuugaaguccucuac

**Ear Nerve**

SerAlaThrArgSerSerThrProThrMetGluHisHisPheAsn  
agugcgacacguucgucaacuccgaccauggagcaccacucaau

**Embryonic Differentiation**

ArgTyrPheIleSerArgGlnTyrProAlaProSerGluSerArg  
agguacuuuuuucgaggcaauaccugcaccguccgaaaguaga

**Endonuclease**

SerMetLeuThrThrLeuHisSerIleArgGlnValAsnTrpAla  
uccauguugacuacgcuccacucgaucagacagguaaacugggcc

**Epidermal Growth Factor**

CysLysArgPheArgGlnAspTyrLeuSerAspArgAlaGlnLys  
uguaagcgguuccgacaagauuaccugagugaucgcgcgcagaag

**EGF (Epidermal Growth Factor) Receptor**

ArgArgGlyCysTyrHisSerArgCysAsnValCysGlyLysHis  
cgaagggggugcuauacagccggugcaacgugugugggaaacau

**Excitatory Enzyme A**

CysLeuTyrLeuArgAlaAlaSerLeuThrGlnLeuValAsnGln  
ugucuguaucucagggcagcgagucuuaccaguuagucaaccag

# G-NETIX

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## **Excitatory Enzyme B**

PheSerAlaCysSerSerSerAlaArgSerSerGlyProGlyArg  
uucucggccugcucgucguccgcccgcaguucgggcccagggcgc

## **Eye**

LeuLeuHisThrLeuAlaAspArgSerAlaSerProLysValGly  
uugcuacacacgcucgucagauagaucugcuagcccaaggguaggc

## **Female Hormone**

ThrAspSerSerArgAlaValGlnSerArgProLeuTyrGluSer  
acagacaguucgcgagcugugcaaagucggccccucucagagagu

## **Fish**

GlnSerValSerTrpCysAlaIleSerLeuMetGluGluValVal  
caucaguaucguggugcgccauaucgcucauggaggaaguggua

## **Frog**

CysIleValLeuValAlaGluValArgThrProIleSerSerCys  
ugcauaguucgugggucgaggugaggaccccuauuuccaguugc

## **Gorilla**

AsnProThrCysAlaGlyAspSerLysAspProLeuLeuValHis  
aauccaaccugcgcggggggaugcaaggauccguauuagugcac

## **Growth Hormone**

IleAspSerProProProAspLeuLysGlnArgAlaIleIleArg  
aucgacucuccgccccggaucaagcagcugcgaucauucga

## **Growth Hormone Receptor**

TyrSerLysArgAspValLysProAsnArgArgArgSerGlyGly  
uauagcaagcgggauguaaaaccaaccggcguaggucgggagga

## **Head**

LeuSerAlaCysSerHisPheLeuCysArgAlaThrGluLeuVal  
uugagugcaugcucccacuuuuuanguagagcuacugaauuggc

## **Heart**

LeuTrpAlaGlySerAlaSerGlySerSerTyrArgGlnProAsn  
cuuugggcccguuuccgaguggcuccucauauccggaaccau

## **Heart Nerve**

GlyAsnProSerAsnSerSerIleLeuGlyAlaIleArgValGln  
ggcaacccaucgaaauucgaguauacugggagcaauuagagugcaa

## **Homeotic**

ArgLeuArgGluHisArgHisMetGlyArgLysHisArgArgLeu  
cgucuacgcgaacacagacacauggggcguaagcaccgaagaug

## **Hormone Release**

ProGlySerArgLeuLysProSerGlnAlaHisValArgPheGly  
cccggguccaggcucaagcccucacaagcacacguacgauucggg

## **Human**

GlyAlaAspAlaAlaProThrThrAspThrGlnSerAlaValIle  
ggcgccgaugcggcucccagaccgacgacgcaaucggcugucauc

## **Inhibitory Enzyme A**

AlaLysSerMetMetAsnSerProLeuLeuHisLeuThrLeuIle  
gcgaaaaguaugaugaacucaccuuuacuacacuaaaccuuaa

## **Inhibitory Enzyme B**

ThrGlySerArgGlnThrAsnArgHisThrCysValSerArgVal  
accggcuccaggcagacgaaccgacacacaugcgucagucgaguu

## **Insect**

AlaLeuLysProSerAlaGluHisAlaThrGlyValAspArgSer  
gcuugaagccuucagccgagcaugcaacagguguugauagguca

## **Interferon**

AlaAlaArgGlyGlyPheGlyStp  
gccgcucgaggaggauucgguaaa

## **Late Stage Differentiation**

ArgLeuAspLeuLysAlaLeuGlnIleValAsnTyrArgSerArg  
cggcuggaucucaaagcacuccaaauagugaauuauucgucuccgc

## **Left Arm**

LeuThrValTyrArgGlyThrGlnPheValPheThrIleAlaVal  
uuacaguuuacagagguacacaguuugucuuuacuaucgccguc

# G-NETIX

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## **Left Leg**

AlaLysThrLeuValSerAsnArgLeuPheValIleAspAlaAsn  
gcuaaaacuuuggucagcaauaggcuauucguuauugaugcaaac

## **Lung**

LysPheProSerSerValValThrCysGluGlnAlaHisTrpAla  
aaguuuccgucgucgucguaacuugugagcaggcacacugggcc

## **Lung Nerve**

GlnLeuArgGlyTyrCysAspHisValHisPheArgLeuArgGly  
caacuccgaggguaauugugaucauguucacuucaggcuacgcgcc

## **Male Hormone**

AlaAspArgGlnThrCysLeuLeuPhePheLysAlaAsnSerThr  
gcggaccgccagacaugcuauuuauucuuuaaggccaauaguacc

## **Memory**

ArgProTyrIleGlyTyrProLeuPheSerLeuLeuAsnTrpPhe  
aggcccuacaucggguauccgcugucagucuaacuaaaauugguuc

## **Methylase**

SerAspTrpSerAspAspAlaSerAlaCysHisSerLeuAlaLeu  
ucggauuggucagauaugcgagugcgugucauagccuagcacuc

## **Mouth**

HisThrValTyrSerValSerProThrAsnLeuLeuAspLeuPhe  
cacacaguguacaguguuaguccaaciaaccuaauuggaccucuuu

## **Muscle**

LeuTrpAlaGlySerAlaSerGlySerSerTyrArgGlnProAsn  
cuuugggccgguuccgccaguggcuccucauauccggcaaccaau

## **Muscle Nerve**

LysAspTyrThrProValAlaTyrArgIleLeuAlaLysTyrTyr  
aaggacuacaccccgguagccuauagaauucuuagccaaauacuau

## **Myo**

SerGlyAlaAsnPheArgThrAlaArgValSerGlyAsnLysThr  
ucgggcgcgaauuuccgcacagcacggguuuccggcaacaagaca

## **Myosin 1**

SerAlaGlyTyrSerGlyGluGlyAlaPheIleAsnArgAlaAla  
ucugcagguuacuccggcgagggggcguucaucaaccgugcugcu

## **Myosin 2**

AlaPheAspValLeuLeuLeuGlyProGlnLeuAlaTyrSerPro  
gcuuucgauguucuccuauugggcccccaacuugccuacucacca

## **Nerve**

IleSerLeuLeuMetValValAspAlaHisPheIleIleHisPhe  
auaagccuacugauggucguugaugcccacuuuaucauccauuuu

## **Nerve Growth Factor**

IleValSerAspGluGlyLysThrIleLysCysValValThrLeu  
auagucuccgacgaaggaagaccuaucaaguguguagugaccua

## **Nerve Growth Factor Receptor**

GlyValCysAspArgPheLeuGluGlyAlaIleSerGluArgArg  
ggcguaugcgaccgcuucuuuggaggaggagcauacagugaacgccgg

## **Night Vision**

LeuLeuGlyArgCysAspSerIleTyrHisHisTrpProAsnCys  
cuauuaggccggugugauucuauuuuaccaucacuggccuauugu

## **Norepinephrine**

ProSerAsnAlaLeuPheAsnGlySerValTyrLysValSerArg  
ccaucaaaugcacuuuuuuaugguucuguaauaaggugucccg

## **Nose**

SerAlaArgAsnLeuLysGluGlnIleAlaThrIleArgAspGly  
ucagcacguaaucuaaaagagcagauugcgaccuauagggauggc

## **Optic Nerve**

TyrTyrAlaAlaProArgGluAspAlaIleThrSerAlaArgAla  
uacuaugcugcaccgccggaggagcgcuauuacgagugcccgcgca

## **Organ**

IleLeuAspArgAsnProProTyrAlaArgAlaGlyLeuGlyVal  
auuuuagaccgaaaccccccauauugcucgagcgggacuaggcguc

# G-NETIX

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## **Osteoprotein**

SerIleIlePheGlyAspThrSerIleLeuValLeuAsnProThr  
agcauuauuuucggcgacacaucauucucguccucaauccgacc

## **Parts (first half)**

IleCysSerAlaArgValArgSer  
auaugcucagcuagaguucgcagu

## **Parts (second half)**

LeuThrIleValProAsnSer  
cuuaccaucgucccaauagc

## **Radiation Repair**

LeuTyrArgArgSerProGlyGlyValIleSerSerLeuLeuSer  
cuauaccgucggagcccuggagggguuauaucuucucuguuauca

## **Right Arm**

HisThrGlnTyrPheAspLeuGlnThrPheLeuLeuSerIlePro  
cauacucaguuuuucgauuuacaaaccuuccuccuguccauuccc

## **Right Leg**

GluCysTyrArgThrGlyLeuGlySerAlaPheCysValLeuAla  
gaaugcuaccgcacaggccuugggucgcguuuuguguucucgca

## **Shaker Syndrome**

ProIleGluSerSerIleThrArgValIleValAsnAsnLeuSer  
ccgaucgagucucgaucacuagggugauaguaaacaacuugucu

## **Steroid Gland**

IleCysGlyArgValMetCysMetPheThrValLysThrPheAla  
aucugcgguaagagucaugugcauguucaccguaaagacguuugcu

## **Steroid Receptor**

LeuThrAsnThrSerLeuAlaLeuArgGlyPheGlyHisGluVal  
uuacaaaauacaagcuuggccuugcggggauucgggucaugaggug

## **Steroid Stimulation**

GlyGlyAlaArgLeuGluIleSerLysValCysAlaArgArgLeu  
gguggggcaagguuagaaaauagcaagguuugugcccugcgcuu

## **Steroid Synthesis A**

ValValLeuAsnLysSerSerValArgSerThrValLysAlaSer  
guaguccucaauaagucgucaguucgcagcacaguuaggcaagc

## **Steroid Synthesis B**

SerMetValGluLysMetLeuArgLeuTyrGlyGluValValAsn  
ucaauggucgaaaaaugcugagacucucacgggagguaguaaac

## **Temperature Sensitivity**

LeuThrTyrArgGlyIleLeuLeuGluAsnSerIleThrGlyHis  
cuuaccuauugcuggaauuuugcuggaaaauucacucuggccau

## **Thyroid Gland**

LeuLeuValArgGluLeuArgSerAsnArgSerSerIleTyrLys  
uugcugguaagagaacuccggucaaacagauccuccauauacaag

## **Thyroid Receptor**

ArgValTyrHisProSerPheLeuSerLeuArgLysAlaAspAsn  
cgcgucuaccaccauccuuucuucauuacgcaaggcagauaac

## **Thyroid Stimulation**

SerLeuArgLysAlaAspAsnArgValTyrHisProSerPheLeu  
ucauuacgcaaggcagauaacccgcgucuaccaccauccuuucuu

## **Thyroid Synthesis 1**

LeuThrThrMetHisArgAspTyrAsnProGlnArgTyrGlySer  
uuuaccacuauagcaccgugacuauaacccgcagcgcuauaggguca

## **Thyroid Synthesis 2**

ArgSerLysValGlyGluAlaAlaMetGluProAlaGlnGlyGly  
cgaagcaaaguaggggagggcggccauggaaccgcgcaaggcggg

## **Torso**

AsnLeuCysGlnGlnProLysThrHisLeuValProLysGlyCys  
aaccugugucagcagccaaagacgcauuuggucccgaagggaugc

## **Toxin Binding**

ThrHisLysLeuCysGluIleGlyHisGlyGlnGlnAlaArgPhe  
acucauaaaauaugcgaauagggcacggacagcaggcgcuuuu

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## tRNA Tyrosine

ArgSerValAspArgLeuArgThrIleLeuThrSerAlaLysTyr  
cgcuccguggaccgacugcguacaauauaaccagugcaaaaauac

## Troponin

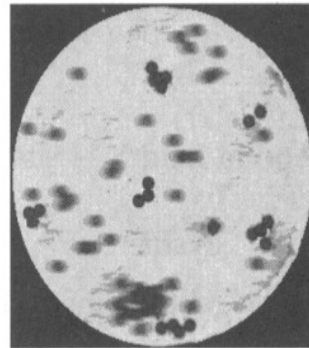
SerLeuIleSerAlaHisAlaThrThrAsnValLysArgThrAsn  
ucucugaucuccgcacacgacgacaacuaauguuaagcgacaaaau

Amino Acid		DNA Codons			
Ala	Alanine	CGT	CFF	CGC	CGA
Arg	Arginine	TCT	TCC	GCT	GCG GCC GCA
Asn	Asparagine	TTC	TTA		
Asp	Aspartic acid	CTG	CTA		
Cys	Cystine	ACG	ACA		
Gln	Glutamine	GTT	GTC		
Glu	Glutamic acid	CTT	CTC		
Gly	Glycine	CCT	CCG	CCC	CCA
His	Histidine	GTG	GTA		
Ile	Isoleucine	TAT	TAG	TAA	
Leu	Leucine	AAT	AAC	GAT	GAG GAC GAA

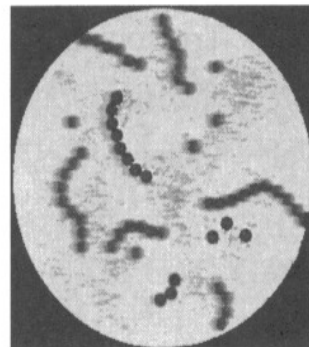
Amino Acid		DNA Codons			
Lys	Lysine	TTT	TTC		
Met	Methionine	TAC			
Phe	Phenylalanine	AAG	AAA		
Pro	Proline	GGT	GGG	GGC	GGA
Ser	Serine	TCG	TCA	AGT	AGG ACG AGA
Thr	Threonine	TGT	TGG	TGC	TGA
Trp	Tryptophan	ACC			
Tyr	Tyrosine	ATG	ATA		
Val	Valine	CAT	CAG	CAC	CAA

## Appendix F

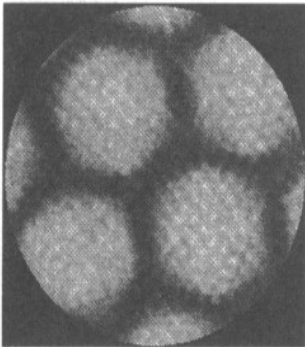
### Bacteria Samples



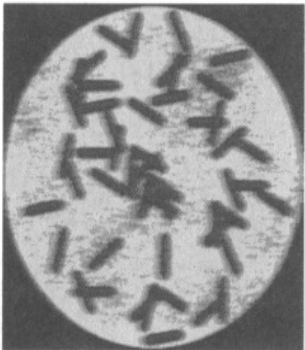
**Purple Gram Positive cocci clusters** should be treated with **Antibiotic B**. Despite treatment, the embryo will die if the torso's Antibody protein is absent.



**Purple Gram Positive cocci chains** should be treated with **Antibiotic A**. The embryo will die if the torso's Antibody protein or Steroid hormone is absent.



**Viral infection B** will not occur unless the torso's Interferon protein or Steroid hormone is absent. Fixing the affected genes will cure the infection.

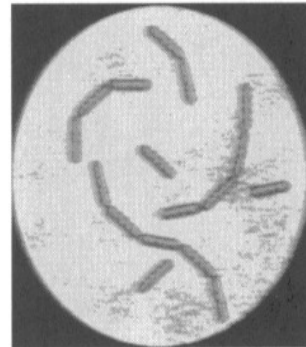


**Purple Gram Positive rods** should be treated with **Antibiotic C**. Despite treatment, the embryo will die if the torso's Antibody protein is absent. This infection makes the culture medium more acidic.

# G-NETIX

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## Bacteria Samples



Pink Gram Negative rods should be treated with Virus A. Despite treatment, the embryo will die if the torso's Antibody protein is absent or the Endonuclease or Methylase genes are mutated. This infection also makes the culture medium more alkaline.



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