Getting Started with the Genetics Kit

by Lis Morris

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This series of tutorials is designed to give you an easy start into the world of genetic engineering in the Creatures 3 game. Each tutorial deals with a different gene type, and is designed to give you an idea of what each gene type is capable of, plus create an interesting new creature for your game. There is no need to read the tutorials in any particular order - simply skip to the tutorial dealing with the gene type you're interested in. Please click here to download a sample pack of genomes and Norns made using each tutorial.

The Basics

Some basic knowledge is necessary before starting on the tutorials.

The genomes of the basic three Norns are found in your creatures 3\genetics\ folder. They have much longer names than in previous games, such as Norn.expressive.civet.47.gen.

Note that files ending in .gno are not genome files, but are used to store the comments on each gene you see in the genetics kit organ and gene editor windows.

All genomes end in .gen. The genomes of Norns within your game are stored in a different folder: creatures 3\my worlds\nameofworld\genetics\. You can find out which genome belongs to which creature within your world by selecting a creature, clicking upon its name and then choosing the Norn tab in the birth agent that appears on screen.

The 'moniker' of the Norn is the name of the .gen file where the Norn's genome is kept. Note that although this name is hideously long and impossible to remember, the second part of the moniker is a memorable word that can help you spot the right genome without writing all the other bits down.

After starting the Genetics Kit, you can load a genome simply by pressing the 'load genome' button in the middle of the front page. This will bring up a dialogue box where you can find your chosen genome, and load it. Once loaded, the genome's details and any comments will be visible on the genetic kit's various pages.

It can take a while for a genome to load - be patient. There are many different pages in the Genetics Kit, but for this tutorial, the main ones used will be the Gene Editor and Export pages.

The gene editor window shows a list of all genes in the loaded genome, initially in the order that they appear in the gen file, although they can be rearranged by any of the gene details in the table, such as gene type or sexual dependency. Double clicking on any row brings up the editing window for that specific gene.

The contents of the editing window varies according to the gene type. The gene type is given in the last right hand column of the gene editor window. When you edit a gene, you will notice that every gene can be specified to switch on at a certain life stage or in a specific sex, and the probability of mutation and deletion etc in future generations can be altered.

After you are satisfied with your genome, you will probably wish to hatch a Norn with the new genes. To do this, turn to the Export page. Make sure that the 'virgin birth' box has a tick in it, unless you wish to combine your genome with another one, as if two Norns had mated. Choose the sex you wish, and set the genus to the species of your new creature's genome. Make sure the creatures 3 game is running, then click 'export'.

A report box will show you the CAOS code used to export the genome, and an egg will appear in your world just beneath the incubator. Unlike egg layer and natural layings, the egg will be full size. It will hatch naturally in time, or can be speeded up in the incubator.

If you change the genome of a Norn currently in your world, please note that the effects will only be obvious in the Norn's offspring, unless you make appearance changes, such as colour or Norn type alterations.

Changes to a Norn's biochemistry are carried silently in the genes, and passed on to the next generation, where they may be partly smothered by the inheritance of normal genes from the other parent. If you wish to make changes to a genome, it is best to create a new Norn with each change to see if your changes produce the desired effect.

The genome I have used in most of these tutorials is Norn.civet46.gen.brain.gen, simply because it has a full .gno comments file, and I happen to like Civet Norns!

Tutorial One - Appearance genes: Making a Grorn

Whether a Norn looks like a Bengal, Civet or Bruin Norn is genetically specified by the appearance genes. The appearance gene directly control which sprite files are used to build the image of the Norn.

There are a total of 26 possible breeds for each species in the game, but currently only a few are used. The breed slots are named A to Z for each species: Norn, Grendel, Ettin and the mysterious geat species. Therefore, a type A Ettin will look different to a type A Norn. However, there is nothing to stop you using Ettin type appearance genes in a Norn, or vice versa. In this tutorial, you will make a Norn that looks like a Grendel, but still acts like a Norn. It will be able to pass on its appearance to its offspring, resulting in some seriously freaky looking kids.

Let's get started with the Genetics Kit

1. Start the Genetics Kit, and load the genome 'Norn.Civet46.gen.brain.gen'.
2. Turn to the Gene Editor page, and gene no. 25, the head appearance gene. Double click on the gene to open the appearance gene editing window.
3. You'll see that this gene has three different areas that can be altered: body area, Parts ID, and species of body part donor. A normal Grendel uses the appearance of a type A Grendel, so alter the the part's ID to A, and the species to Grendel. Incidently, don't alter the body area part of the gene - if you do that, you risk specifying different sprites for the same body part twice, and not specifying any sprite for the head. This, sadly, doesn't result in headless Norns, but a Norn with a default Bruin head.
4. The head of the Norn will now be a Grendel type head. However, there are the other body parts to alter, too. Find genes 074, 113, 365, and 441. These genes specify the other four body parts. Alter them to a type A Grendel too.
5. Export and hatch a Norn - male or female, it doesn't matter - in fact, if you've never seen a female Grendel, you may find this quite interesting.

Tutorial Two - Facial Expressions: Making an Astonished Norn

The facial expression genes control, you'll never guess, the facial expressions. The expression a Norn pulls at any one time is genetically specified by the Norn's current emotional state. The emotional state of a Norn is controlled by the Norn's drives. These drives have names such as 'hunger for protein' or 'loneliness'. A particular expression is used when a drive, or a set of drives, is high. For instance, Norns have a special 'sleepy' expression. The happy face is used when the Norn doesn't have high levels of pain, tiredness, boredom, or anger. However, it is easy enough to change that!

1. Start the genetics kit, and load the genome 'Norn.civet46.gen.brain.gen'.
2. Turn to the gene editor page, and gene no. 444, the happy expression facial expression gene. Double click on the gene to open the appearance gene editing window.
3. The gene editing window allows you to edit the expression used, the drives that will cause that expression, and the weighting, or importance, given to that particular expression.
4. Change the expression used from expression 1 to 4. This will change the expression from the happy to the scared one. Feel free to set it to something else if you wish, but be careful - using too high a number will cause the game to crash as it looks for non-existent expressions!
5. Export your Norn into your world, and have a good giggle!

Tutorial Three - Pose and Gait genes: The Norn with a Limp

As Norns walk about in the world, they adopt a number of different poses and gaits, according to mood. Two different gene types control the Norn animations: the pose gene, and the gait gene. The pose genes code a single pose, and the gait gene strings these poses together to make an animation, just like a cartoon.

To get different gaits at different life stages, the pose genes can be edited to switch on at a certain time of life. Norns have two sets of pose genes: those that switch on as an embryo, and those that come on as a child. The embryo pose genes specify a series of crawling poses, whereas in the child stage, the Norn walks on two feet. In this tutorial, we'll make a Norn that walks on two feet as a baby, and limps all the time.

1. Start the genetics kit, and load the genome 'Norn.civet46.gen.brain.gen'.

2. Turn to the gene editor page, and look for genes 758, 759, 760 and 761. Click on one of them, and then click the 'delete gene' button.

3. The kit will ask you for confirmation. Click yes. Do the same for the other three genes. This will delete the embryo crawling poses, which we no longer want in this case. Note that it does take a while, especially on slow computers, for a gene to be deleted. The genetics kit hasn't crashed, honest.

4. Look for genes 603 - 606. These are the child limping poses. Strung together, they make the limping gait. Double click on one of them, and take a look. It is possible to edit which pose is specified, and also alter the pose itself. Altering poses is very difficult, since spotting a pose as a creature moves about isn't easy, and figuring out what the string should be in the first place for a particular pose needs serious thought, too.

   Basically, each letter in the pose string refers to one body part, in this order: Direction, Head, Body, Left Thigh, Left Shin, Left Foot, Right Thigh, Right Shin, Right Foot, Left Upper Arm, Left Lower Arm, Right Upper Arm, Right Lower Arm, Tail Root, Tail Tip. Obviously, direction isn't a part of the body: in this case, 0= away from camera, 1= facing the camera, 2= facing right, 3= facing left, X= carry on as before, ? = towards it, ! = away from it.

   For the other body parts, 0 - 3 specify a pose from far down to far up, and X means carry on as before. Anyway, alter genes 603 - 606 so that they switch on at the embryo stage.

5. Look for gene 466, the normal gait gene. Double click on it to edit it. You'll see that a total of eight poses can be added to a gait. The gait cycles through these poses in turn, ignoring blank slots. The normal gait

uses the four normal poses. Replace these with each of the four limp poses instead.

6. Export your Norn, and watch it totter around! You'll notice it still uses the other crawling gaits when it's doing something other than normal walking.

Tutorial Four - The Genus Gene: A Wolf in Sheep's Clothing

Without the genus gene, a genome is not functional - it will not produce a creature. The genus gene performs two functions - it tells the creature what species it is, and also who its parents were, or rather, what the moniker of its parents was.

In this tutorial we'll make a distinctly dangerous Norn - a Norn with entirely Grendel genetics, except for the genus gene. It'll look and sound just like a Grorn, but will hit Norns, steal eggs, and generally cause Grendelish havoc. You have been warned!

1. Start the genetics kit, and load the genome 'gren.final46g.gen.brain.gen'.
2. Turn to the gene editor page, and find gene 000, and double click on it to start editing. You'll see that the mother and father's moniker can be changed, as can the creature's species. Change the species from Grendel to Norn.
3. Export and hatch your nasty little Norn! Try putting a gadget next to it. You'll see that its immediate reaction is very Grendelish - to hit it. You might wish to keep this charming creature away from your breeding population.

Tutorial Five - Instinct and Stimulus Genes: Making a Vulture Norn

Since instinct and stimulus genes look very similar, even if they don't have a very similar mode of operation, we'll consider them together. Both gene types tie a certain action to a particular set of emotions, for instance, there's an instinct to run away from other Norns if crowded. However, the two genes act upon the Norn's action in a very different way.

Stimulus genes specify exactly what happens internally in the Norn when a particular event takes place, whereas instinct genes are merely suggestions of possible actions in situations where the Norn has not had a chance to learn a good response.

The instinct genes don't make a Norn, for instance, push a lift call button when they're high up, but it makes this a more likely than random action if the Norn does not know what to do. Instincts are processed during sleep, like dreaming, which is why it's very important for your Norn in any creatures game to get its head down occasionally. In a way, stimulus and instinct genes are exact opposites - stimulus genes specify what happens after an action, while instincts specify what should lead to a particular action.

In this tutorial, we'll alter a Norn to make it able to eat and enjoy 'manky', or rotten food, and give it an instinct to search out rotten food when hungry.

1. Start the genetics kit, and load the genome 'Norn.civet46.gen.brain.gen'.
2. Rotten food is full of proteiney goodness, if you can stomach it, so we'll tie in eating carrion to the hunger for protein drive. Turn to the gene editor page, and find gene 453, the instinct to eat food when hungry for protein.
3. Double click it to open the gene editing window.
4. You'll see that at the top of the gene editing window, a series of circumstances can be set. These can be used to set up an imaginary situation in the Norn's dreams. Scroll through and take a look.

   The current set circumstance is the noun lobe reading ID 11. This corresponds to food. You can find out what the other game object's ID are by using the Brain in a Vat kit from the CDN. The ID for 'manky' is 9. So, change the box that says 'It is ID 11', to 'It is ID 9'. You'll notice that the rest of the editing window specifies how to reward given a certain response.

   Remember - this isn't what actually happens in your Norn when it eats, but what its instincts will tell it do when hungry. Find gene 454. This instinct gene teaches a Norn that eating fruit when hungry for protein is a good thing.

The ID of fruit is 8. Change this, again, to 9. Now the new born Norn will search for rotten stuff when hungry for protein, not fruit. However, at the moment, it will still suffer ill effects from eating manky stuff.

5. Find gene 506, the 'eaten manky' stimulus gene. This specifies which chemicals the Norn will get in its system from eating rotten foodstuffs. Double click on it to open it.
6. You will see that you can set the stimulus being referred to, a possible response, and the chemicals the Norn receives as a result of performing this action.

   Set the chemicals and sliders as follows: Hunger for Protein, -0.202, Protein, 0.105, Unused, 0, Unused, 0. This means that eating rotten stuff will now reduce hunger for protein, and give the Norn some protein as well. It doesn't alter your Norn's ability to eat normal nornish foods, such as fruit and food. They're still just as good for this Norn as for others.

7. Export and hatch your Norn. Teach it to talk, and then see its reaction when another Norn states that it is hungry for protein. There's bad advice if ever you heard it!

Tutorial Six - Pigmentation and Pigment Bleeds: A Metallic Norn

Possibly the easiest genes to get a pleasing and quick result from, the pigment genes alter the colour of your Norn. Pigment bleed genes switch red and blue values in the Norn's image, whereas pigmentation genes add a specific amount of red, blue or green to the Norn's pigmentation. As a general rule, pigmentation alterations cause a much more dramatic effect, but that doesn't mean that pigment bleed mutations can't be very pleasing to the eye. In this tutorial, both pigmentation and pigment bleed genes will be altered to create an odd, metallic blue Norn.

1. Start the genetics kit, and load the genome 'Norn.civet46.gen.brain.gen'.

2. The first job is to delete the genes that specify new coloration on entering adolescence. Since we want our Norn to be the same colour throughout its life, we only need the embryo switch - on pigment genes.

   Turn to the gene editor page, and delete genes 370, 372, and 382 - 387 inclusive (please note these are the numbers these genes have before you start deleting genes!). The genetics kit will pause for a long time after deleting the genes, because it has to renumber the existing genes. If you choose to leave these genes intact, be warned that the gene numbers will be wrong for the rest of this tutorial, and you'll have to hunt them all down manually!

3. There are quite a few pigment genes scattered through the genome. The best way to find them all is to reorganise the gene list according to gene type. To do this, scroll to the right hand side of the gene list in the gene editing window using the horizontal scroll bar, and click the grey heading of the type column, assuming you have a standard colour windows desktop (as if anyone actually does...). This will reorganise the genes according to type. Scroll down the list of genes until you find the Creature: Pigment genes. They are after the Creature: Instinct genes in alphabetical order. Right after the pigmentation genes should be the pigment bleed genes. The relevant genes numbers are 366 - 376 inclusive, and 377 to 399 for the pigment bleed genes.

4. Double click gene 366 to begin editing. You'll see that this gene codes for redness of the Norn. Other pigment genes code for blue or green. The colours are additive - if you have a Norn with high red and green pigmentation, it'll appear yellow, just like mixing coloured light. Set the value for red pigmentation to 0 using the slider. Edit all the other pigment genes so that they are all set to 0, too. This will make the Norn very dark in colour, since all pigment values are set as low as possible.

5. Double click on gene 377, the first of the three pigment bleed genes. You'll see that two values can be altered here: rotation and swap. Rotation and swap alter the red and blue pigmentation by switching or

rotating their values with each other. Set the swap to zero to give your Norn a bluish tinge. Find the other two pigment bleed genes, and also alter their swap to zero.

6. Export your Norn. Pretty colour, isn't it?

Tutorial Seven - Organ and Receptor Genes: Food Allergy, Anyone?

The organs are a vital part of Norn anatomy. All biochemical reactions are divided up into different organs. The different organs can function at different rates, according to demand.

For instance, the Liver Catabolic is involved in breaking down energy stores to liberate energy. The Liver Anabolic, a separate organ, is involved in the exact opposite- making energy reserves for the long term. In a Norn that has just eaten, the anabolic liver works faster than the catabolic. This can be reversed in a Norn that has excess energy stores and hasn't eaten in a long time.

The organs can also be damaged by various environmental factors. Most organs start off 100% health when the Norn is born, then very slowly lose health as the Norn ages.

The life force of the organs is made up of two parts- short term life force, and long term life force. Short term life force is reduced easily by damage and accidents, but can be healed. Long term life force cannot be healed - it can be thought of as how much of that organ is left in the Norn. When long term life force reaches zero, that organ is dead.

Depending on how important the organ is, the Norn might be dead, too! Organs can be examined in more detail using the biochemistry kit, available from the CDN.

The receptor genes can be thought of as the interface between the Norn's chemical and physical systems. It is a way in which the chemical state of a Norn can affect non-chemical attributes. For instance, a receptor can make a certain level of a chemical cause a particular walk. Receptors are also used to transmit the current state of the Norn's drives (hunger, pain, etc) to the brain. Without these drive receptors, the Norn couldn't learn from past experiences when that emotion was high.

Receptors also affect organ health. They can affect organ health either positively, or negatively- for instance, a receptor for the heavy metal poison in the immune system organ causes heavy metals to slowly degrade that organ. However, many organs have positive receptors for prostaglandin, and these receptors help the healing process, and the recovery of short term life force.

In this tutorial, we'll make a new organ, and add a receptor that causes the Norn to sneeze when it eats fat. Over time, this organ will be detrimentally affected by fat, until it loses all life force, at which point, the Norn will return to normal.

1. Start the genetics kit, and load the genome 'Norn.civet46.gen.brain.gen'.

2. Switch to the gene editor page, and press the New Gene button. Choose an organ type gene, and press 'create and close', since you only want to make one organ in this tutorial.
3. The Genetics Kit will ask for a caption for this organ. Call it 'Food Allergy'. The organ gene editing window will appear.
4. You'll see that organs have a number of sliders that can be set. The values each of these sliders represent can be seen in the bottom bar of the main genetics kit window.

   Set the Clock Rate to 0.5.

   Organ Vulnerability alters how fast the organ will naturally decay. Set this to about 0.35.

   Life Force Start Value represents how healthy the organ is in a new born Norn. Set this to 0.5. Most organs start off entirely healthy, for obvious reasons. This one will start already down to half its maximum possible health.

   Biotick Start represents the initial rate the organ will work at- set this to around 0.5.

   Finally, set the ATP damage coefficient to about 0.5 as well. The ATP damage coefficient alters how much very low energy levels damage this organ. These alterations will give us a fairly delicate organ that is easily damaged. However, as yet there is nothing specific that will damage it.

5. Organs contain receptors, emitters and chemical reaction genes. To make a gene part of an organ, it must appear after it in the gene list, before the next organ gene. Genes between two organ genes in the genome are neatly pigeon holed into the first organ.

   Our receptors must be in the organ gene, so if we create them immediately after the new food allergy organ, they will be part of that organ. Genes can be moved from organ to organ using the move up-down buttons by the side of the gene editing window.

   Click the new gene button and choose the Chemical Receptor gene type.

   Click Create, and call the gene 'Fat Sneezing'.

   The receptor gene editing window will open. As you can see, you can specify what action or area of the Norn the receptor is attached to, which chemical it is affected by, and three other sliders: threshold, nominal, and gain.

Without getting horribly mathematical, Threshold controls how high the level of chemical has to be before the receptor is activated. Nominal controls what minimum level the receptor attachment point is set to when the receptor fires, and gain controls how quickly the intensity of the receptor firing increases as the level of the chemical increases. If the 'digital' checkbox is marked, then the receptor works in an on - off fashion - the attachment point is either set at the Nominal level, or is not firing. If the other 'Output Reduces' checkbox is ticked, the receptor works in the opposite way - low levels of the chemical will cause it to fire, rather than high levels.

Set the receptor attachment of the gene to Creature, Sensorimotor, Involuntary Action 2. Involuntary Action 2 is sneezing.

Other involuntary actions include coughing, laying eggs, and dying! Next, Specify the chemical to be Fat. Set the threshold to about 0.01, the nominal to 0, and gain to 1. This means that for any amount of the fat chemical above 0.01, the 'Involuntary Action 2' value will be set to the same value as the amount of fat. A non-zero value for this attachment point will cause a sneeze.

6. Close the 'Fat Sneezing receptor, and you'll find the new gene box still open behind it. Make sure it is still set to 'Chemical Receptor' and choose Create and Close this time.

   Name the new gene 'Fat Damage'.

   Set the receptor attachment point this time to Current Organ, <no tissue>, Injury.

   Set the chemical to Fat, and then set the threshold to about 0.01 again, the nominal to 0, and the gain to 1. This means that the more fat there is in the Norn's system, the more damaging it will be to the Fat Allergy organ. You may notice that the organ is specified in a box at the top of the receptor editing window, and it says that this is the food allergy organ.

7. Close the receptor editing window, and export your Norn. Try feeding it some cheese. You'll find that as it grows up, there will come a point where cheese or other food types no longer affect it in this way - the organ has died.

Tutorial Eight - Biochemical Emitters: A Gill Norn

Emitters are in many ways the opposite of receptor genes. Receptor genes allow the chemical status of the Norn affect its physical attributes - such as life stage, gait, etc. Emitters do the exact opposite - they allow the physical state of the Norn affect the chemical.

Emitters are attached to a locus - that is, a particular information point of the Norn's system, such as the time of year, life stage, etc, and emit a chemical depending upon that physical attribute. Emitters are very powerful genes, and dramatic alterations in the Norn's behaviour can be made by altering a single one. In this tutorial, we'll make a Gill Norn - a Norn that needs to be underwater to breathe.

1. Start the genetics kit, and load the genome 'Norn.civet46.gen.brain.gen'.
2. Turn to the gene editor page, and find gene 143, the air emitter gene. Double click on this gene to edit it.
3. If you have already done the receptor tutorial, the layout of the emitter editing window will be very familiar to you. There is a top section in which the physical locus is chosen, and a bottom section which controls the chemical emitted, and how much of it is emitted at any time. The sample rate, gain, and threshold control how much of the chemical is emitted, given the value of the physical locus.
4. Sample rate controls how often the chemical is emitted; gain is a scaling factor - a high gain means lots of the chemical is emitted, whereas a low gain means that little is emitted; and threshold is the minimum value the locus must have for the emitter to fire at all. If the emitter is set to digital (the radio buttons in the middle of the window), the amount of chemical emitted every sample is given by the gain, but if it is set to analogue, the gain is multiplied by the value at the physical locus to give the amount of chemical emitted.

   The air emitter emits air according to the air quality - as you can see, air quality is 1 above water, and 0 below. Therefore, air is emitted into the Norn's system when the Norn is above water, and not below. Air is later converted into large amounts of oxygen, and used up by the Norn's metabolism.

   Find the bottom check box 'Invert input signal'. This will make the emitter work the opposite way round, so that air is emitted only when the Norn is underwater.

5. Making a Gill Norn is as simple as that! Close the emitter editing window, and export your Norn, and hatch it. I'd advise you to have activated the 'pick up Norn' power up first, though... or your Norn might have problems. Try placing it in the aquarium, and watch its air levels, by connecting a numerical input tool to a chemical grapher, and setting the numerical input to 29.

Tutorial Nine - Half Life Gene: Making a long lived Norn

All good things must come to an end, as they say, and this applies to the chemicals within a Norn's body, too. All the chemicals used by the Norn's biochemistry decay over time. The rate at which they decay is given by the half life gene. You may be familiar with the term 'half life' from reports on nuclear power etc, but in fact it can be used to describe anything that decays exponentially.

An exponential decay is one that slows down over time. A chemical with a half life of 1 day, for instance, will have half of the original amount left after one day. After another day, half of that half will have disappeared, so that after two days, only a quarter remains. After three days, one eighth will remain. The amount remaining keeps getting smaller, but the amount by which it reduces also gets smaller. The decay of chemicals within the Norn's systems doesn't quite follow this pattern, due to the way it is programmed, but it is close enough that the term half life is a good description.

The length of a Norn's life is given by the decay of a chemical called 'Life'. This chemical starts off at the maximum amount at birth, and when it decays away to nothing, the Norn dies of old age. Therefore, it is possible to alter the length of a Norn's life by altering the rate of decay of this chemical.

1. Start the genetics kit, and load the genome 'Norn.civet46.gen.brain.gen'.
2. Turn to the gene editor page, and look for gene 026, the half life gene. You'll notice that there is only one half life gene in the genome. Double click on the gene to edit it.
3. You'll see that there is a list of all the Norn chemicals, and that the half life of the selected chemical can be altered using the slider. Scroll down to the Life chemical, 125. Click on it so that it is highlighted.
   If you look at the bottom of the main genetics kit window, you'll see it says 'Slider: 99 (Halflife of 15.0 minutes)' Alter this half life to 106. This gives us a half life of 29.9 minutes, which means the Norn will live twice as long.

4. Export and hatch a Norn. You'll notice it takes longer to reach each life stage. It will probably leave behind more offspring, too - which means that eventually, all your Norns could be longer lived. Nice to see evolution in action.

Tutorial Ten - Initial Concentration Genes: Happy to be Alive!

When Norns are hatched, there are already some chemicals present in their bloodstream, even though no chemical reactions have taken place yet, and no emitters have fired. This is exceedingly necessary - imagine a Norn born without any oxygen in its system - it might suffocate before it took its first breath! The Initial Concentration genes specify the chemical state of the Norn as it hatches. After birth, these genes are irrelevant - they play no further part in the Norn's metabolism.

Norns are born hungry and bored, to encourage them to do something interesting immediately after birth. However, they don't have to be born in this state.

1. Start the genetics kit, and load the genome 'Norn.civet46.gen.brain.gen'.
2. Turn to the gene editor page, and look for gene 013, which specifies the initial concentration of boredom in the Norn. Double click on it to open it.
3. The initial concentration gene has quite a simple format - the only things that can be altered are the chemical, and the amount of that chemical at birth. Set the amount of chemical to 0. You can see the current value of the slider at the bottom of the main genetics kit window.
4. Find genes 120, 121 and 136. These are the three initial concentration genes for the three hunger drives. Reduce them all to 0 in the same way as you did for the boredom initial concentration gene. Incidently, simply deleting these genes has the same effect as setting them to zero.
5. Export and hatch your Norn. You may notice that it doesn't make an instant beeline for the food, or toys. If you feel like cheating, trying pressing ctrl+shift+C, and typing in 'targ Norn vocb', and pressing ctrl+shift+C again. You've just given the Norn the full vocabulary instantly. Try asking it to 'express'.

Tutorial Eleven - Chemical Reactions: Immunity to Glycotoxin

Chemical reaction genes are pretty self explanatory. They control the chemistry within the Norn, saying that, for instance, starch is broken down into glucose, and how fast this can happen. Many genetic alterations that could be done using other, more complicated gene types can be made using only the chemical reactions genes, and some thinking. They are, perhaps, the most important genes to look at if you wish to get a thorough understanding of Norn biochemistry - a look at the reactions explains most of what is going on.

Glycotoxin is a poison that destroys the Norn's main glucose store: glycogen. This reaction is controlled by a chemical reaction gene, and is therefore easy to remove. Glycotoxin poisoning is quite a common illness in Norns, caused by eating detritus.

1. Start the genetics kit, and load the genome 'Norn.civet46.gen.brain.gen'.
2. Look for gene 341, the glycotoxin poisoning reaction. Double click on it to open it.
3. You'll see that glycotoxin combines with glycogen, producing a small amount of glucose and coldness. The amount of glucose made from the glycogen by breakdown in this manner is far less than the amount made from glycogen in a healthy Norn. We're not actually going to alter anything in this gene, but it's worth looking at.

   Close the reaction gene editing window, and go back to the main genetics kit window. Delete gene 341. Deleting a gene does take some time, since all the other genes have be renumbered, so don't worry - your genetics kit has not crashed, honest!

4. This Norn now has no poison reaction to glycotoxin. Export and hatch a Norn with the genome. Try feeding it some detritus...the jungle is a good place to look.

Tutorial Twelve - Brain Lobes and Tracts: Emergent Behaviour in Action

Most gengineerers take one look at the Norn brain, scream briefly, and promise never to go near the horrible thing again. On the surface, it looks horribly complicated - all those dendrites, and State Variable Rules. Undoubtedly, it is horribly complicated, when you get into all the details - that's why Creatures Labs employs special experts simply to make the brain. However, the basic pattern of the brain, and the way it learns, is easily understood.

The Norn brain consists of a number of brain lobes connected together with dendrites. The lobes are each a grid of squares, where each square on the grid is a neurone. Neurones are basically placeholders - they store information that the game engine then interprets.

The clever part of the brain is found in the dendrites. Dendrites links neurones in different brain lobes together, carrying information between neurones. They travel one way only - from one neurone to another, so that one neurone can affect the state of another one, but not vice versa.

Some dendrites always stay in the same place, communicating between two set neurones for the entire Norn's life. Other dendrites are capable of moving about within the brain, although they always connect between the same two lobes. These movable dendrites have connections that can be strengthened or weakened, and when a dendrite connection becomes very weak, the dendrite wanders off and reconnects elsewhere. Therefore, this can be used to store memories of important and not so important events in the Norn's life.

The brain can be divided into three basic parts: information collection, information processing, and output. Most of the brain lobes are dedicated to collecting information about the Norn's environment - for instance, there is a lobe in which neurones fire if the hand says a particular verb. Each neurone of that lobe has a different verb associated with it. Funnily enough, this is called the verb lobe.

Another lobe records what the Norn is currently looking at. There are many other lobes involved in this information collection part of the Norn thought process. All these information collection lobes have dendrites that connect them to the combination lobe, which is the area where the information is processed.

The dendrites to the combination lobe are movable ones - dendrites that are used often, or record a particular traumatic event in the Norn's life are stronger than less important events - so that, for instance, being hit by a Grendel would result in very strong dendrite connections, since this causes a lot of fear and stress in the Norn. Pushing a stone of knowledge would leave a much weaker impression, since Norns get no particular emotional 'buzz' from doing this, unless the hand tickles them for it. The combination lobe, then, is comparable to our memory - we too remember important events far longer than non important ones.

The final part of the Norn brain is the decision lobe. This is connected to the combination lobe, and this is where the memories of actions is used to decide upon the best action in the current situation. If you wish to see a Norn brain in action, you might wish to try using the Brain in a Vat kit from the CDN.

You'll probably realise that in a model as subtle and complex as this, a tutorial that produces magical results is simply out of the question. The whole point of emergent behaviour is that the exact behaviour cannot be specified - it arises out of the whole system. Generally, to produce dramatic changes in the behaviour of a Norn involves changing not only the brain structure, but emitters, receptors, chemicals and chemical reactions. However, this is our last tutorial, so lets have some fun and make a Norn that follows the hand around obsessively!

To do this, we won't actually be altering the brain at all, but making a new receptor that fires the 'hand' neurone in the noun lobe constantly. To learn more about receptors, go to tutorial seven.

1. Start the genetics kit, and load the genome 'Norn.civet46.gen.brain.gen'.

2. Turn to the gene editor page, and press the 'new gene' button. Choose 'chemical receptor' and press 'create and close'. Name the gene 'Hand Obsession'.

3. Set the attachment of the receptor to Brain, Tissue 2: noun, Neuron (1) State (0). Set the chemical to ATP. Why ATP? Well, we want this receptor to fire constantly, and ATP is always high in a live Norn, so it'll do nicely.

   Set the threshold to 0, the gain to 1, nominal to 1, and make it a digital receptor by clicking on the bottom checkbox. Neurone 1 of the noun lobe is the neurone that is fired when the word 'hand' is heard by the Norn.

4. The new receptor is currently in the brain organ, which simply won't do. Use the move gene up and down buttons to move the gene up from 811 to 766, where it'll be the last gene in the muscle organ. Ok, still not exactly a sensible place for it to be, but what the heck.

5. Export and hatch your genome. You'll find that the Norn will constantly look at the hand when it is present, but will act entirely normal when the hand is not in sight. This is because neurones are fired in the noun lobe when the Norn hears a noun - so to the Norn its like having a voice constantly whispering

'look at the hand, look at the hand, look at the hand', but hopefully not quite as annoying for the Norn. If there is no hand to look at, the Norn ignores the information from this neurone in making its decision process, and carries on as normal. If we had connected the receptor to the stimulus source lobe instead, it would be the equivalent of making the Norn hallucinate the hand's presence, and the Norn would simply vacillate and starve to death.