

# Preface

This book teaches you basic modern genetics, surveys the most important scientific papers and provides information about the genetics of modern domestic strains.

The chapters on modern genetics theory could have easily expanded into a book twice this size. But I think that is unnecessary. The point of learning genetics theory is to be a more intelligent and perceptive observer of guppy patterns and their inheritance patterns. This book has just enough knowledge for the guppy geneticist hobbyist.

The tendency in the hobby is to treat individual genes as responsible for multicolored patterns on the body of the guppy. But I think in the course of the book you will discover that most of the guppy “color genes” actually play a role in *regulating the expression of other genes*. The blond and golden genes, for example, regulate the size and location of black color cells. The Asian Blau gene plays a role in the proper development of all the main classes of color cells.

The current view is to see genes as the software that drives the color hardware of the body, the color cells. A lot of guppy genetics research comes down to debugging strange color anomalies that occur when the guppy color software develops bugs. The Black Moscow that does not fade when under stress is an example of a phenotype due to a genetic switch that has remained “on” when it should have shut “off.” It is not a pattern, it is a error in a signalling pathway. The difference is fundamental...molecular in fact.

A much more fascinating picture of the guppy color emerges from such a study. Instead of seeing guppy genes as little prepatterns that you shuffle like a deck of cards, you see them as switches that you can turn on and off, allowing you to become a programmer of beauty. Programming Beauty. That sounds like the title of a book.

After rebooting your view of guppy genetics, I then take you on a short journey through the past, reviewing what I consider the major papers of guppy science.

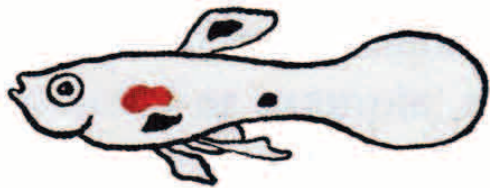
It is a fascinating journey.

Many of the scientific papers are difficult to find, sometimes in the literal sense. I found O. Winge’s famous 1927 paper, “The location of eighteen genes in *Lebistes reticulatus*,” J. Gen. (3):1-37, in the Simon Fraser University basement archive. I had to muster all the strength of my body to move the metal stack of books that sat in front of it. But I was determined to get my hands on one of the most important paper ever written about guppy genetics.

In laying the groundwork for understanding his paper, I am also laying the groundwork for an understanding of all the scientific papers that follow. All the basic topics of guppy genetics are brought up in the paper, or I bring them up in the context of the paper.

I think that if you understand the Winge paper, you have a good basic grasp of guppy genetics and the papers that follow will be easier to understand.

Some people doubt the value of old scientific papers, especially guppy scientific papers, because the field of genetics has grown and matured immensely in the past hundred years. But what escapes this narrow view is the value of the data found in these old papers. Winge and the other scientists recorded extremely useful observations in their guppy labs. For example, Winge wanted to know if he could alter a trait through selective breeding. So he tried breeding the spot out of his *Maculatus* laboratory strain.



*The black spot is found on the dorsal fin of the Maculatus strain.*

He breeds the strain for several generations, selecting males that have the smallest and least colorful spot. He tells us that the spot seems to disappear during one generation. But its reappearance in a subsequent generation convinces him that the trait was not lost, it was just suppressed. This is good solid information that every breeder should have in their mental repertoire.

Winge seems to suggest the black spot is due to a single gene. Winge's view that the spot is due to a "black spot gene" now seems quaint, given what we have learned about the way genes are regulated and how they participate in biological pathways. But his careful observations of the behavior of the spot over many generations are accurate, and his prediction that you cannot use selective breeding to rid this type of strictly Y-linked trait from a strain (out damn spot!) is timeless.

This is valuable information for the guppy hobbyist trying to get rid of an aesthetically displeasing mark on a strain of guppies. Given that the average

hobbyist does not have the time, training, patience or facilities for conducting extensive genetic experiments, the old papers are gold mines of data worth mining.

Because of the excellent quality of the research, the early papers make good stepping stones to modern papers. At the end of the 1944 paper, "The Cellular Expression and Genetics of two New Genes in *Lebistes reticulatus*," H.B. Goodrich and his colleagues speculate about the possible relationship between the *blond* and *golden* genes. They did not have the theory in place to understand the relationship between the two genes, that was to come in the next decade. But their observation that the two genes seem to "regulate" the expression of black in the guppy was prescient. I place the term *regulate* in parenthesis because the concept of gene regulation lay in the future. But in thinking about the old data in the context of modern theory, suddenly a whole dimension of guppy genetics opens up.

I have found the other papers that I review to be abandoned gold mines, that I have gone back to, and after doing a little digging, I have come up with some extremely valuable nuggets.

Nayudu and Hunter's two 1979 papers are full of these. They pioneered a method that I have found particularly useful in my own home lab. Most of the hundreds of guppy scientific papers that talk about guppy color genes merely cite Winge or talk about guppy colors in a very abstract way. Nayudu and Hunter actually look at them down through the tunnel of a microscope. It's amazing what you can find when you look a little past the end of your nose.

Their drawings of the *Cp* and *Flavus* genes are not mere academic exercises. I have discovered them in crosses between wild guppies and domestic strains. Their work is a real stepping stone to modern color cell research.

Not all the book is theory. In fact only one-third

of its pages are devoted to genetics theory and the old guppy papers. The rest of the book is filled with information that has flowed directly out of my fish room.

The number of crosses I have documented and analyzed stands at about 25 at the time this book was first written. So the majority of the information in this book is about the genetics of cultured guppies. And most, but not all, that information comes from my direct observation of the outcome of crosses.

In writing about the genetics of mutations like Asian Blau and Magenta I apply the theory that is in the first third of the book to the rest of the book. I follow the scientific methodology of the guppy genetics pioneers, generating good data from my crosses that I can return to again and again. It is a process of developing theories, testing those theories against further observations, generating new crosses to test theories and then modifying theories to fit better data.

I have enough critics in the guppy community to keep me honest. And I must admit some of my theories have been highly speculative. But to some extent they have had to be speculative because so little data has been available to me. There are lots of theories about guppy genes, but few people have published solid data that forms the foundation of theories, and which ultimately the theories rise or fall on.

I now have seven years of photographic documentation (including microscope and digital camera studies) and written documentation to base my theories on.

What really surprised me in the middle of writing this book over the past three years was that one of the keys to guppy genetics was there all along, unnoticed in my microscope studies. And a theory that has earned me public castigation for its speculative nature fell into place when I discovered the

biological basis for it in my microscope slides. That's huge.

This book is partly an odyssey through guppy genetics and partly a teaching tool. It has a deliberate teaching structure to it. I begin with a simple introduction to genetics. This forms a basis on which to discuss the scientific papers. The scientific papers introduce more advanced genetics topics. Then I discuss those topics in the light of modern genetics research. Finally I apply all that knowledge to modern guppy mutations. To bring the whole journey to a close, I provide a couple of chapters that show exactly how I practice genetics analysis.

In one example I "reverse engineer" the Galaxy guppy, showing you how I use genetics theory to explore the combination of genes that make this guppy beautiful. In a second example, I show how I used research and practical breeding methods to create a new and unique strain, the See-Thru guppy.

It's been a long journey. But I have the feeling the journey has just barely started. Thank god.

### *Acknowledgements*

Many of the insights I have gained into guppy genetics have benefited from conversations I have had with fellow guppy genetics enthusiasts. I have participated in many discussions on the phone, via e-mail and on the Guppy Designer forum and other forums around the Internet. Throughout the book I acknowledge those people whenever the source of the insight came from outside my fish room. I am truly grateful for their enthusiasm and generous sharing of pictures and breeding knowledge.

