

# Sex Chromosomes Vary

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**Evolution of sexual systems, sex chromosomes and sex-linked gene ... - Nature.com**

*Complex evolutionary processes maintain an ancient chromosomal ... - pnas.org*

[A novel quantitative targeted analysis of X-chromosome inactivation ... - Nature.com](#)

[Choosing Sexes](#) - Kristen J. Navara 2018-02-01

There is extensive evidence that vertebrates of all classes have the ability to control the sexes of

the offspring they produce. Despite dramatic differences in the mechanisms by which different taxa determine the initial sex of

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offspring, each group has found its own way of adjusting offspring sex ratios in response to social and environmental cues. For example, stress is a well-known modulator of offspring sex in members of all groups studied to date. Food availability, and limitation in particular, is another common cue that stimulates biases in offspring sex ratios in a wide variety of species. Offspring sex can be adjusted at the primary level, which occurs prior to conception, or at the secondary level, during embryonic development. While the mechanistic pathways that ultimately result in sex ratio biases and the developmental time-points sensitive to those mechanisms likely differ among taxa, the key involvement of steroid hormones in the process of sex ratio adjustment appears to be pervasive throughout. This book reviews the systems of sex determination at play in different vertebrate groups, summarizes the evidence that members of all vertebrate taxa can facultatively adjust offspring sex, and discusses when and how these adjustments can take place.

*Sex Determination in Vertebrates* - 2019-04-16  
Sex Determination, Volume 134, the latest release in the Current Topics in Developmental Biology series, contains current reviews in the field of vertebrate sex determination. It covers molecular pathways of sex determination in genetic and environmental species and encompasses both sex determination of somatic lineages and commitment of germ cells to male or female fate. Chapters in this new release cover, amongst other topics, Mapping the Sox9 Enhancer Elements, Epigenetic Regulation of Sex Determination, Evolution and Management of Sex Chromosomes, Regulation of Germ Cell Sex Identity in Medaka, Control of Sex Determination in Zebrafish, Sexually Dimorphic Germ Cell Identity in Mammals, and more. Contains reviews written by leading experts in each field Includes informative figures that illustrate principle points that are useful for teaching Written in a style that is clear and simple

**Exploring the Biological Contributions to Human Health** - Institute of Medicine

2001-07-02

It's obvious why only men develop prostate cancer and why only women get ovarian cancer. But it is not obvious why women are more likely to recover language ability after a stroke than men or why women are more apt to develop autoimmune diseases such as lupus. Sex differences in health throughout the lifespan have been documented. Exploring the Biological Contributions to Human Health begins to snap the pieces of the puzzle into place so that this knowledge can be used to improve health for both sexes. From behavior and cognition to metabolism and response to chemicals and infectious organisms, this book explores the health impact of sex (being male or female, according to reproductive organs and chromosomes) and gender (one's sense of self as male or female in society). Exploring the Biological Contributions to Human Health

discusses basic biochemical differences in the cells of males and females and health variability between the sexes from conception throughout life. The book identifies key research needs and opportunities and addresses barriers to research. Exploring the Biological Contributions to Human Health will be important to health policy makers, basic, applied, and clinical researchers, educators, providers, and journalists-while being very accessible to interested lay readers.

The Biology of Reproduction - Giuseppe Fusco  
2019-10-10

A look into the phenomena of sex and reproduction in all organisms, taking an innovative, unified and comprehensive approach. *Theory Change in Science* - Lindley Darden 1991 Examines the processes involved in the birth and development of new scientific ideas. The author has searched for strategies used by scientists for producing new theories, both those that yield a range of plausible hypotheses and ones that aid

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in narrowing that range.

*Molecular Genetics of Sex Determination* -

Stephen S. Wachtel 2014-07-23

In this era of accelerated discovery and prolific output, *Molecular Genetics of Sex Determination* keeps readers abreast of this field's fast-moving biology. Its chapters were completed by experts in each area only months before publication. The text is organized into two parts. First, it reviews the basic biology of sex determination and summarizes ground-breaking work in mouse, marsupial, and *Drosophila* systems. Second, it covers current human genetics, clinical studies, and the syndromes of abnormal sex differentiation. With chapters by preeminent reproductive biologists, this is a capital work. Ohno's law is described by Ohno; the Lyon hypothesis, by Lyon; Sinclair tells how he cloned the testis-determining gene; and so on. *Molecular Genetics of Sex Determination* is authoritative, comprehensive, and current. It is prime reading for geneticists, developmental

biologists, graduate students in these and related fields, clinical researchers, physicians, and medical students. Reviews the genetics of sex determination in 19 up-to-date chapters. Features research on sex chromosomes and sex-determining genes. Includes abnormalities of sex determination and clinical genetics. Written by scientists who pioneered work in this field.

**Understanding Genetics** - Genetic Alliance 2009

The purpose of this manual is to provide an educational genetics resource for individuals, families, and health professionals in the New York - Mid-Atlantic region and increase awareness of specialty care in genetics. The manual begins with a basic introduction to genetics concepts, followed by a description of the different types and applications of genetic tests. It also provides information about diagnosis of genetic disease, family history, newborn screening, and genetic counseling.

Resources are included to assist in patient care,

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patient and professional education, and identification of specialty genetics services within the New York - Mid-Atlantic region. At the end of each section, a list of references is provided for additional information. Appendices can be copied for reference and offered to patients. These take-home resources are critical to helping both providers and patients understand some of the basic concepts and applications of genetics and genomics.

### *X Chromosome Segregation During Spermatogenesis in Auanema Rhodensis XX Males* - Emily Ling Xu 2020

During cell division, accurate segregation of chromosomes into two daughter cells is essential to avoid catastrophic consequences. Segregation of the sex chromosomes is particularly important, as it plays a primary role in sex determination. Furthermore, unequal segregation of the sex chromosome during gamete formation can lead to skewed sex ratios. Nematodes are powerful models to study this

process because many nematodes employ an XX/XO sex determination pattern, where XX animals are feminine and animals with a single X (no Y) are male. In the nematode species, *Auanema rhodensis*, meiotic X chromosome segregation fails to follow the normal laws of genetics and instead varies by sex and by gamete. Here, we report X chromosome segregation and cellular component partitioning patterns in an *A. rhodensis* *tra* mutant, where males have two X chromosomes that follow non-standard patterns of X chromosome segregation as part of their normal developmental mechanism. X chromosome segregation in *tra* (XX) males is highly variable due to unique modulations during anaphase I. Post-meiotic partitioning varies with respect to X chromosome segregation. These variations in meiosis and post-meiosis result in the production of more than one type of sperm.

**The Evolution of Sex Determination** - Leo W. Beukeboom 2014

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temperature) or social variables (e.g.

### **Sex Chromosome Evolution in Blow Flies -**

Anne Amarila Andere 2020

Chromosomal mechanisms of sex determination vary greatly in phylogenetically closely related species, indicative of rapid evolutionary rates. Sex chromosome karyotypes are generally conserved within families; however, many species have derived sex chromosome configurations. Insects display a plethora of sex chromosome systems due to rapid diversification caused by changes in evolutionary processes within and between species. A good example of such a system are insects in the blow fly family Calliphoridae. While cytogenetic studies observe that the karyotype in blow flies is highly conserved (five pairs of autosomal chromosomes and one pair sex chromosome), there is variation in sex determining mechanisms and sex chromosome structure within closely related species in blow flies. The evolutionary history of sex chromosomes in blow fly species have not

been fully explored. Therefore, the objective of this research was to characterize the sex chromosome structures in four species of blow flies and investigate the selective forces which have played a role in shaping the diverse sex chromosome system observed in blow flies. The blow fly species used in this study are *Phormia regina*, *Lucilia cuprina*, *Chrysomya rufifacies* and *Chrysomya albiceps*. *Phormia regina*, and *Lucilia cuprina* have a heteromorphic sex chromosome system and are amphogenic (females produce both male and female offspring in equal ratio). In contrast, *Chrysomya rufifacies* and *Chrysomya albiceps*, have a homomorphic sex chromosome system, are monogenic (females produce unisexual progeny), have two types of females (arrhenogenic females - male producers and thelygenic females - female producers), and sex of the offspring is determined by the maternal genotype. To accomplish these tasks, a total of nine male and female individual draft genomes for each of the

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four species (including three individual draft genomes of *Chrysomya rufifacies* - male, and the two females) were sequenced and assembled providing genomic data to explore sex chromosome evolution in blow flies. Whole genome analysis was utilized to characterize and identify putative sex chromosomal sequences of the four blow fly species. Genomic evidence confirmed the presence of genetically differentiated sex chromosomes in *P. regina* and *L. cuprina*; and genetically undifferentiated sex chromosomes in *C. rufifacies* and *C. albiceps*. Furthermore, comparative analysis of the ancestral Dipteran sex chromosome (Muller element F in *Drosophila*) was determined to be X-linked in *P. regina* and *L. cuprina* contributing to sex chromosome differentiation but not sex-linked in *C. rufifacies* and *C. albiceps*. Evolutionary pressures are often quantified by the ratio of substitution rates at non-synonymous (dN) and synonymous (dS) sites. Substitution rate ratio analysis (dN/dS) of homologous genes

indicated a weaker purifying selection may have contributed to the loss of sex-linked genes in Muller element F genes of the undifferentiated sex chromosome as compared to the differentiated sex chromosome system. Overall, the results presented herein greatly expands our knowledge in sex chromosome evolution within blow flies and will reinforce the study of sex chromosome evolution in other species with diverse sex chromosome systems.

**Spectrum of Sex** - Minoru Tanaka 2022-11-07  
This book introduces cutting-edge studies on the spectrum of sex. The sex spectrum can be understood as an interwoven mechanism sustaining graded phenotypes between the two sexes. The book overviews three elements that develop the sex spectrum: genetics, the endocrine system, and the environment. Part I discusses the genetic regulation during sex determination, which often results in a mixture of two sexes or sex reversal. The evolutionary aspects of the genetic determinants are also

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discussed. Part II presents the involvement of endocrine regulation in the sex spectrum, which covers a broad range of phenotypic events, including sexual behavior and metabolism. Interestingly, sex hormones can also act as sex determinants. Finally, Part III shows that intrinsic factors, such as sex-determining genes and sex hormones, are not the only factors in sex development. The environment surrounding organisms, such as symbiosis and metabolism, act on the sex as critical factors, generating the sex spectrum. Determination and development of the two sexes have been a topic of great interest and a long-standing issue in biology. The book updates the conventional view that biological sex is fixed after birth and sets new perspectives for understanding sex as a spectrum manifested in multiple phenomena. Each chapter contributed by leading experts explains the sex spectrum in various organisms and their underlying mechanisms from the latest ongoing studies. The book provides a valuable

resource for not only experts in developmental biology, physiology, and medical science, but also non-scientists and anyone interested in the topic.

**Evolutionary History of Recombination on Sex Chromosomes and of Sex-biased Gene Expression** - Iulia Darolti 2019

Males and females within a species are often under different selection pressures, which can affect both gene sequence and expression. Sex differences in selection are predicted to precipitate sex chromosome formation, and the rate of recombination on sex chromosomes varies greatly across taxa. Examining the extent of recombination suppression on sex chromosomes across closely related species can offer insight into the forces shaping sex differences and sex chromosome evolution over time. Additionally, sex-biased genes are thought to encode sexually dimorphic traits and are therefore a useful way to examine the effect of sex-specific selection across the genome. In this

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thesis, I use whole genome and transcriptome sequencing data to characterise the structure and conservation of sex chromosome systems across related species. I combine this with patterns of sex-specific single nucleotide polymorphisms to uncover the degree of recombination suppression and divergence across poeciliid sex chromosomes, as well as explore the consequences of recombination arrest on gene expression patterns. Finally, I investigate the selective dynamics driving the expression and rate of sequence evolution of sex-biased genes.

**The Genetics of Cancer** - B.A. Ponder  
2012-12-06

It has been recognized for almost 200 years that certain families seem to inherit cancer. It is only in the past decade, however, that molecular genetics and epidemiology have combined to define the role of inheritance in cancer more clearly, and to identify some of the genes involved. The causative genes can be tracked

through cancer-prone families via genetic linkage and positional cloning. Several of the genes discovered have subsequently been proved to play critical roles in normal growth and development. There are also implications for the families themselves in terms of genetic testing with its attendant dilemmas, if it is not clear that useful action will result. The chapters in *The Genetics of Cancer* illustrate what has already been achieved and take a critical look at the future directions of this research and its potential clinical applications.

[Studies in Spermatogenesis \(Part 1 of 2\)](#) - Nettie Maria Stevens 2020-08-12

Reproduction of the original: *Studies in Spermatogenesis (Part 1 of 2)* by Nettie Maria Stevens

[Sex Itself](#) - Sarah S. Richardson 2013-12-13

Human genomes are 99.9 percent identical—with one prominent exception. Instead of a matching pair of X chromosomes, men carry a single X, coupled with a tiny chromosome

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called the Y. Tracking the emergence of a new and distinctive way of thinking about sex represented by the unalterable, simple, and visually compelling binary of the X and Y chromosomes, *Sex Itself* examines the interaction between cultural gender norms and genetic theories of sex from the beginning of the twentieth century to the present, postgenomic age. Using methods from history, philosophy, and gender studies of science, Sarah S. Richardson uncovers how gender has helped to shape the research practices, questions asked, theories and models, and descriptive language used in sex chromosome research. From the earliest theories of chromosomal sex determination, to the mid-century hypothesis of the aggressive XYY supermale, to the debate about Y chromosome degeneration, to the recent claim that male and female genomes are more different than those of humans and chimpanzees, Richardson shows how cultural gender conceptions influence the genetic

science of sex. Richardson shows how sexual science of the past continues to resonate, in ways both subtle and explicit, in contemporary research on the genetics of sex and gender. With the completion of the Human Genome Project, genes and chromosomes are moving to the center of the biology of sex. *Sex Itself* offers a compelling argument for the importance of ongoing critical dialogue on how cultural conceptions of gender operate within the science of sex.

**Sex Chromosomes** - Ursula Mittwoch  
2014-06-28

*Sex Chromosomes* focuses on the study of sex chromosomes, including human chromosomal abnormalities, behavior and characteristics of chromosomes, and cell division. The book first offers information on the chromosomal basis of sex determination, as well as development of the cell theory, mitosis, fertilization, meiosis, and discovery of sex chromosomes. The publication also ponders on the mitosis, meiosis, and

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formation of gametes. Discussions focus on the special characteristics of sex chromosomes, abnormalities of cell division, and sexual differentiation. The manuscript reviews sex chromosomes in plants, *Drosophila*, and Lepidoptera. The book also examines sex-chromosome mechanisms that differ the classic type; sex chromosomes in fishes, amphibia, reptiles, and birds; and sex chromosomes in man. Discussions focus on normal human sex chromosomes, Turner's syndrome, Klinefelter's syndrome, true hermaphrodites, testicular feminization, and pseudohermaphrodites. Sex chromosomes in mammals other than man, including monotremata, marsupialia, insectivora, rodentia, and carnivora, are discussed. The publication is a dependable reference for readers interested in the study of sex chromosomes.

**Sex Chromosome Translocation and Speciation** - Susan Andrea Espinet 1979

Although exceptions may be readily identified,

two generalizations concerning genetic differences among species may be drawn from the available allozyme and chromosome data. First, structural gene differences among species vary widely. In many cases, species pairs do not differ more than intraspecific populations. This suggests that either very few or no gene substitutions are required to produce barriers to reproduction (Avisé 1976). Second, chromosome form and/or number differs among even closely related species (White 1963; 1978; Fredga 1977; Wright 1970). Many of the observed chromosomal differences involve translocational rearrangements; these produce severe fitness depression in heterozygotes and were, thus, long considered unlikely candidates for the fixation required of genetic changes leading to speciation (Wright 1977). Nonetheless, the fact that species differences are frequently translocational argues convincingly for their fixation despite prejudices to the contrary.

Haldane's rule states that in the F of

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interspecific crosses, the heterogametic sex is absent or sterile in the preponderance of cases (Haldane 1932). This rule definitely applies in the genus *Drosophila* (Ehrman 1962). Sex chromosome translocations do not impose a fitness depression as severe as that imposed by autosomal translocations, and X-Y translocations may account for Haldane's rule (Haldane 1932). Consequently a study of the fitness parameters of an X·yL and a yS chromosome in *Drosophila melanogaster* populations was initiated by Tracey (1972). Preliminary results suggested that x.yL/YSmale enjoyed a mating advantage with X·yL/X·yL females, that this advantage was frequency dependent, that the translocation produced sexual isolation and that interactions between the yL, yS and a yellow marker contributed to the observed isolation (Tracey and Espinet 1976; Espinet and Tracey 1976). Encouraged by the results of these preliminary studies, further experiments were performed to clarify the genetic nature of the observed sexual

isolation, S the reality of the y frequency dependent fitness and the behavioural changes, if any, produced by the translocation. The results of this work are reported herein. Although the marker genes used in earlier studies, sparkling poliart and yellow have both been found to affect activity, but only yellow effects asymmetric sexual isolation. In addition yellow effects isolation through an interaction with the T(X-y) chromosomes, yS also effects isolation, and translocational strains are isolated from those of normal karyotype in the absence of marker gene differences. When yS chromosomes are in competition with y chromosomes on an X·yL background, yS males are at a distinct advantage only when their frequency is less than 97%. The sex chromosome translocation alters the normal courtship pattern by the incorporation of circling between vibration and licking in the male repertoire. Finally a model of speciation based on the fixation of this sex chromosome translocation in a geographically



isolated gene pool is proposed.

**Sex Determination in Fish** - T. J. Pandian

2011-09-02

This book is the first to report that research in allogenis/xenogenics has conclusively shown that fishes have retained bisexual potency even after sexual maturity and spermiation. The XY genotype found in the unexpected female phenotypes sired by supermales (Y1Y2) and androgenic males (Y2Y2) points out the need to employ sex specific molecular ma

*Sex Chromosomes and Sex-Linked Genes* -

Susumu Ohno 2013-06-29

Natural selection operates among individual organisms which differ in their genetic constitution. The degree of hereditary variability within a species is greatly enhanced by cross-fertilization. Indeed, the mechanism of sexual reproduction occurred very early in evolution, for it is seen today even in bacteria. In *Escherichia coli*, fertilization occurs by passage of the single chromosome from the male into the

female bacterium (LEDERBERG, 1959). In multicellular organisms, the separation of germ from soma, and the production of haploid gametes became mandatory. The gametes were of two types. One, extremely mobile, was designed to seek out and penetrate the other, which loaded with nutrients, received the mobile gamete and initiated the development of a new individual. The foundation for true bisexuality was thus laid. In the primitive state of bisexuality, whether an individual is to be a sperm-producing male or an egg-producing female appears to be decided rather haphazardly. In the worm, *Banelia viridis*, the minute males are parasites in the female. Larvae that become attached to the proboscis of an adult female become males, while unattached larvae sink to the bottom and become females (BALTZER, 1935). The more sophisticated state of bisexuality was initiated by setting aside a particular pair of chromosomes for specialization and making either the male or the female a

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heterogametic sex. Sex chromosomes as we know them were thus born.

Molecular Biology of the Cell - Bruce Alberts  
2004

## Sex Chromosomes Vary:

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