Extra Chromosomes

Supernumerary Chromosomes

Giant Chromosomes

ACCESSORY CHROMOSOMES

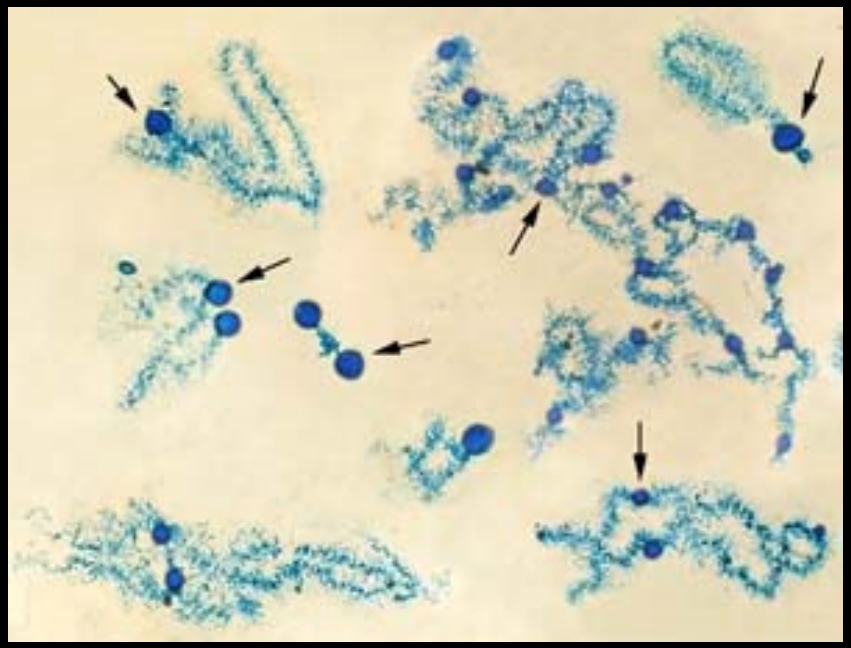
Special Chromosomes

Salivary Gland Chromosomes

Supernumerary Chromosomes

Polytene

Lampbrush



POLYTENE CHROMOSOME

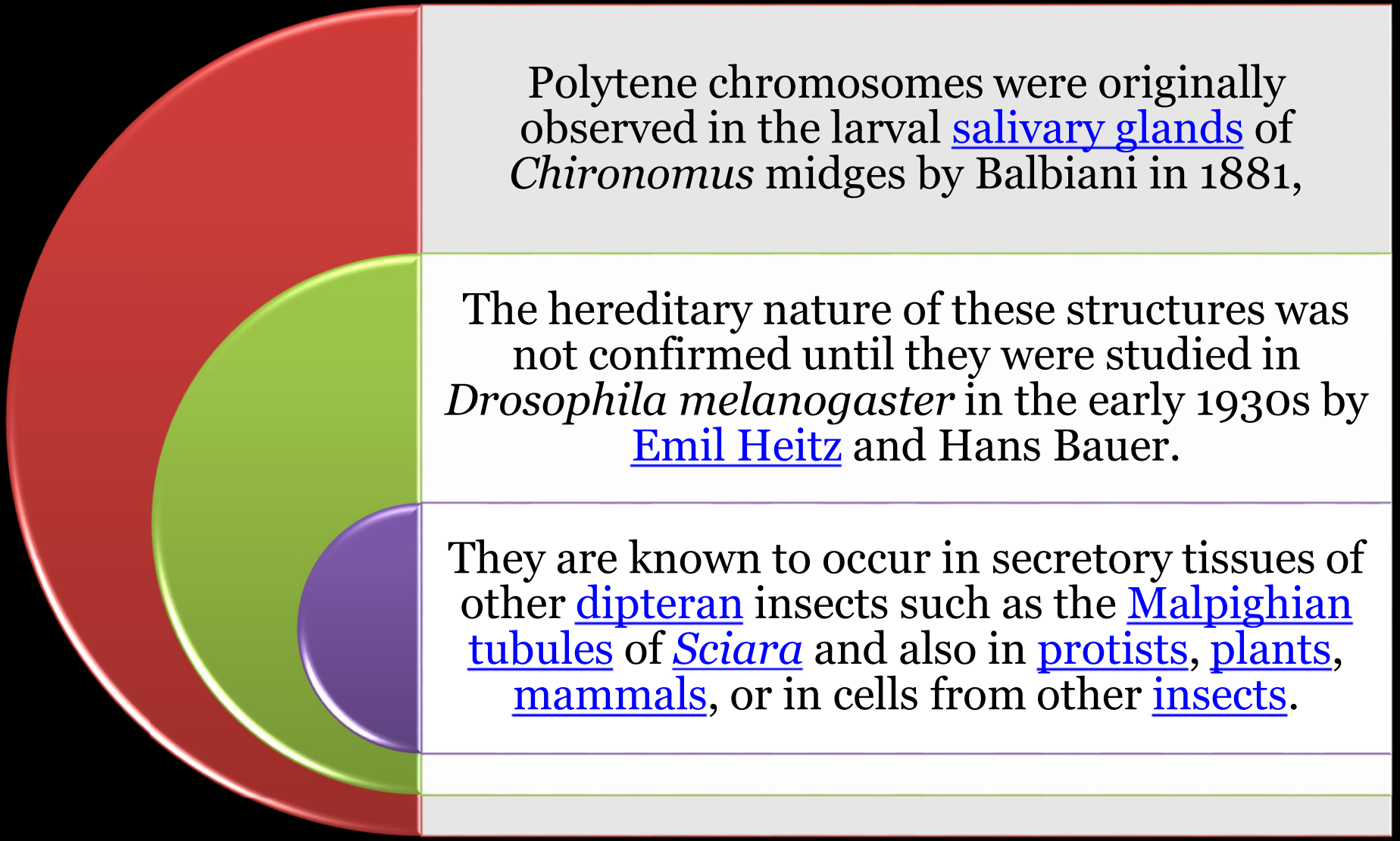
Drosophila melanogaster

Chironomus tentans

CHIRONOMUS TENTANS

Larvae can be found in almost any aquatic or semiaquatic habitat,
including treeholes, bromeliads, rotting vegetation, soil, and in sewage and artificial containers.
Larvae bright red in color due to a hemoglobin analog; these are often known as "bloodworms"

POLYTENE CHROMOSOME



Polytene chromosomes were originally observed in the larval salivary glands of *Chironomus* midges by Balbiani in 1881,

The hereditary nature of these structures was not confirmed until they were studied in *Drosophila melanogaster* in the early 1930s by Emil Heitz and Hans Bauer.

They are known to occur in secretory tissues of other dipteran insects such as the Malpighian tubules of *Sciara* and also in protists, plants, mammals, or in cells from other insects.

POLYTENE CHROMOSOME

Term coined by Koller

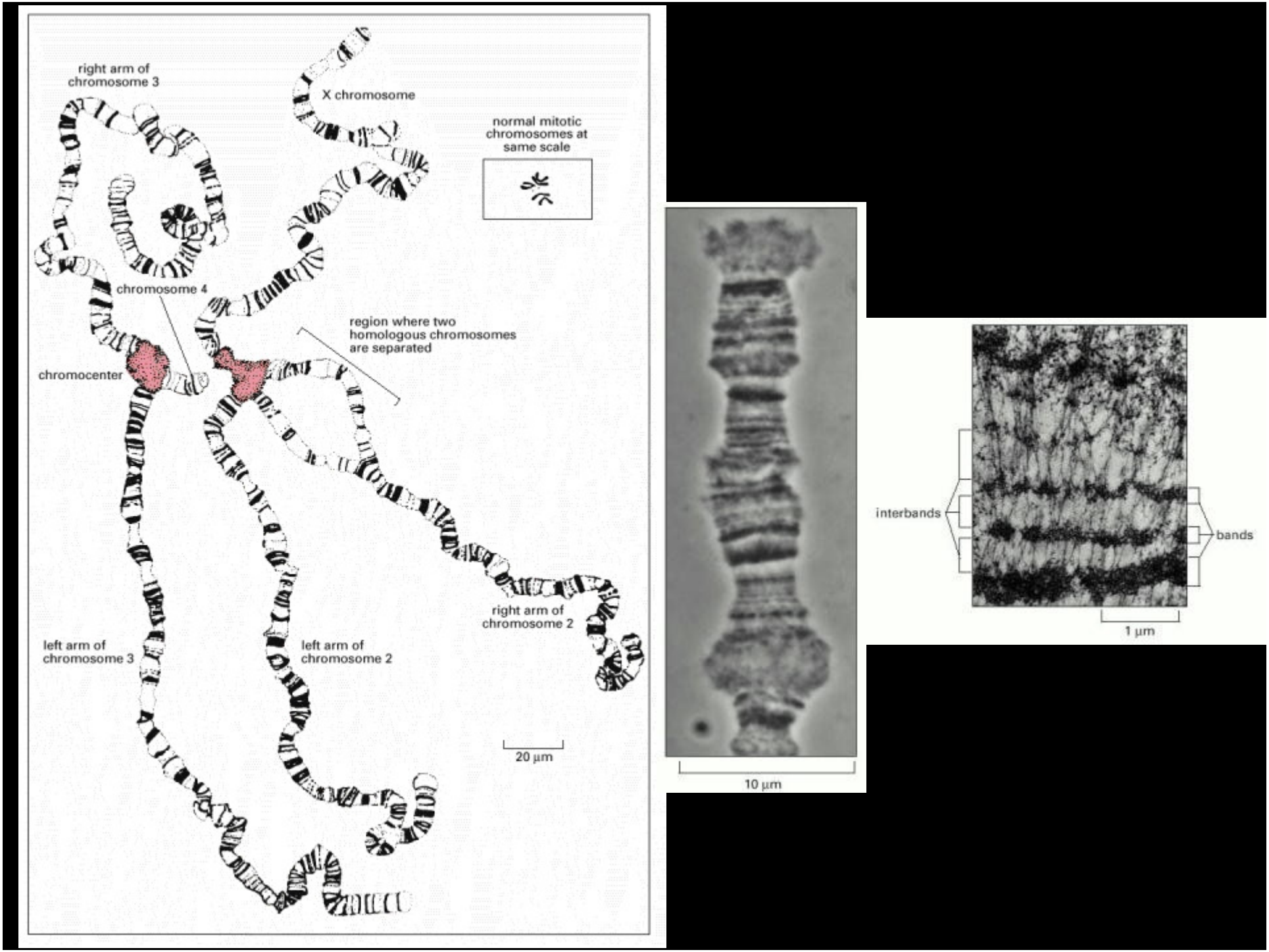
Certain insect cells have specialized chromosome.

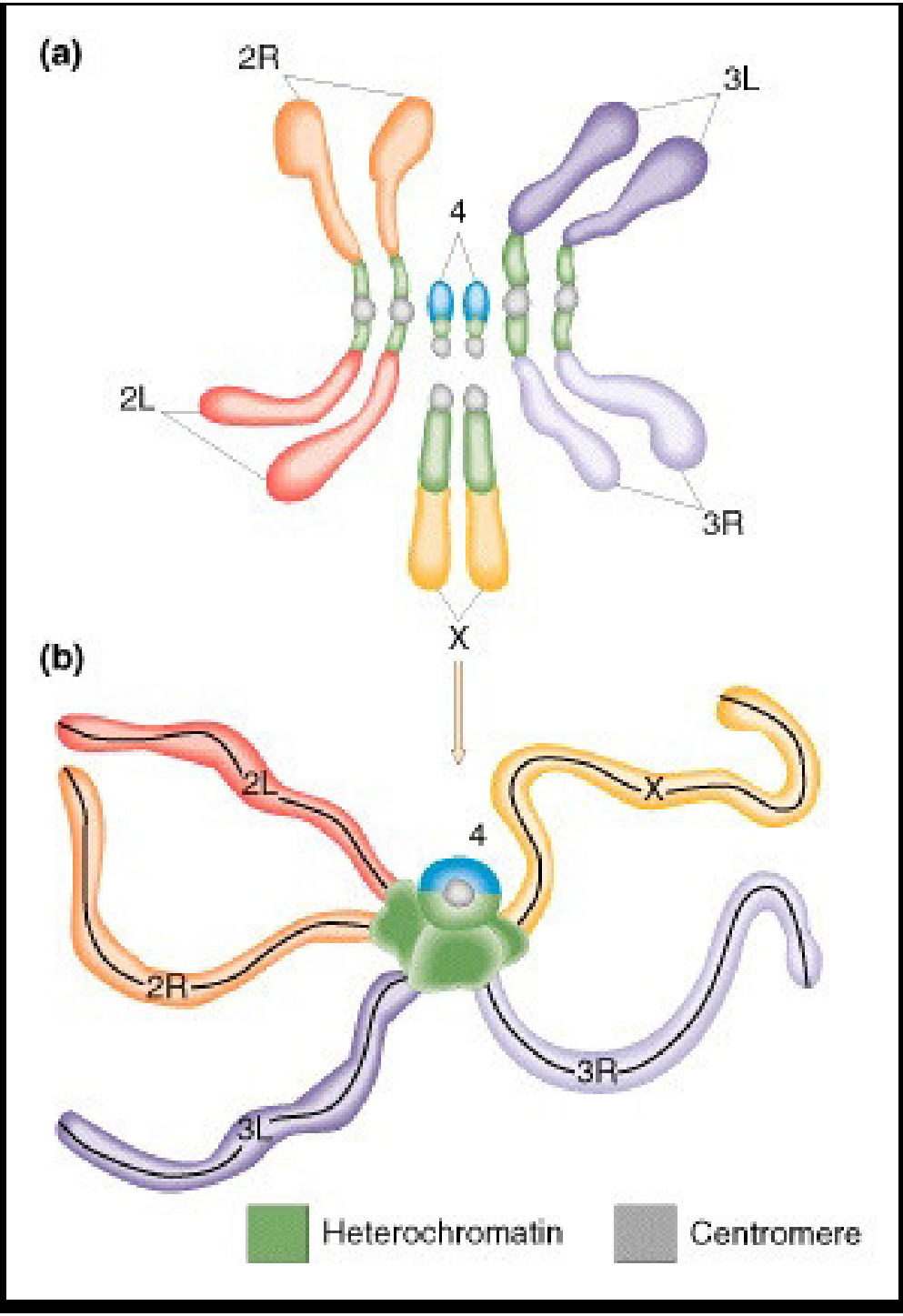
Located normally in **salivary glands** of

- *Chironomus tentans*, a midge/
- *Drosophila melanogaster*, a fruit fly

Other cells has normal chromosomes (2n = 8)

Polyteny - DNA in each of the four *Drosophila* chromosomes has been replicated through 10 cycles without separation of the daughter chromosomes, so that 1024 (2^{10}) identical strands of chromatin are lined up side by side


right arm of chromosome 3
X chromosome
normal mitotic chromosomes at same scale
chromosome 4
region where two homologous chromosomes are separated
chromocenter
right arm of chromosome 2
left arm of chromosome 3
left arm of chromosome 2
20 µm
10 µm
interbands
bands
1 µm


(a)
2R
3L
4
2L
3R
X
(b)
2L
X
4
2R
3R
3L
Heterochromatin
Centromere

POLYTENE CHROMOSOME

About 95% of the DNA in polytene chromosomes is in bands, and 5% is in interbands.

Bands are estimated to contain 3000–300,000 nucleotide pairs in a chromatin strand

There are approximately 5000 bands and 5000 interbands in the complete set.

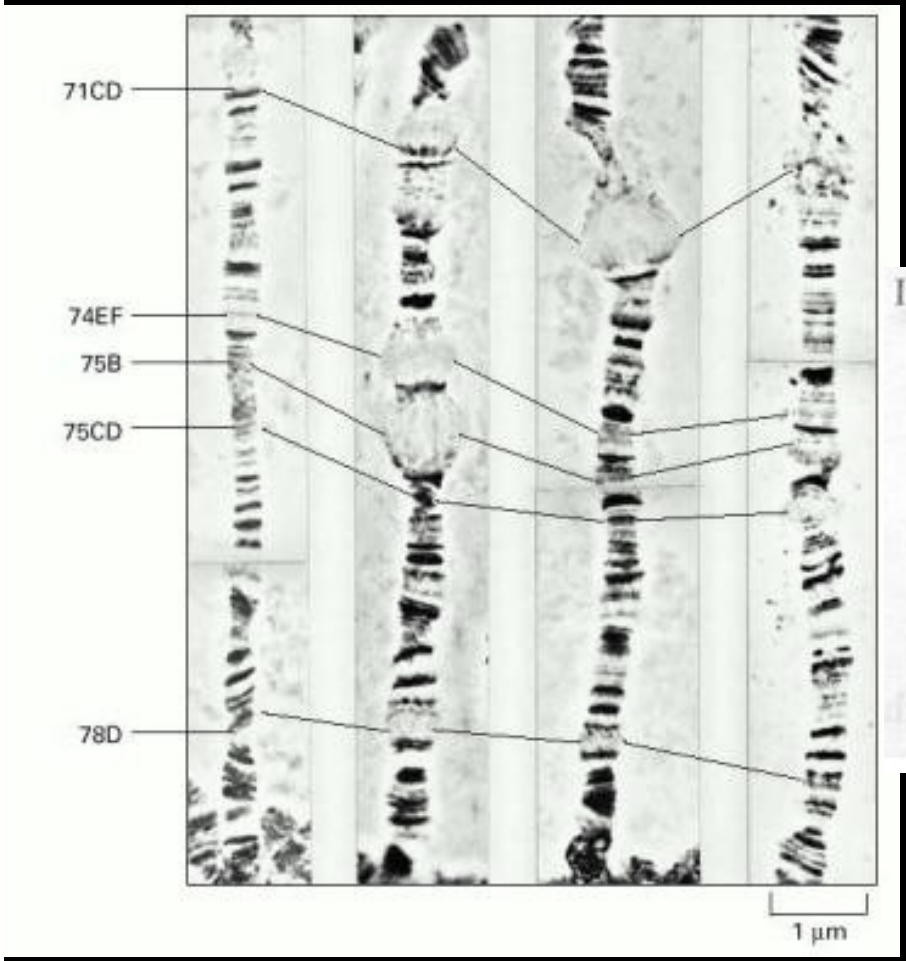
Both Bands and Interbands in Polytene Chromosomes Contain Genes

band-interband pattern reflects different levels of gene expression and chromatin structure along the chromosome

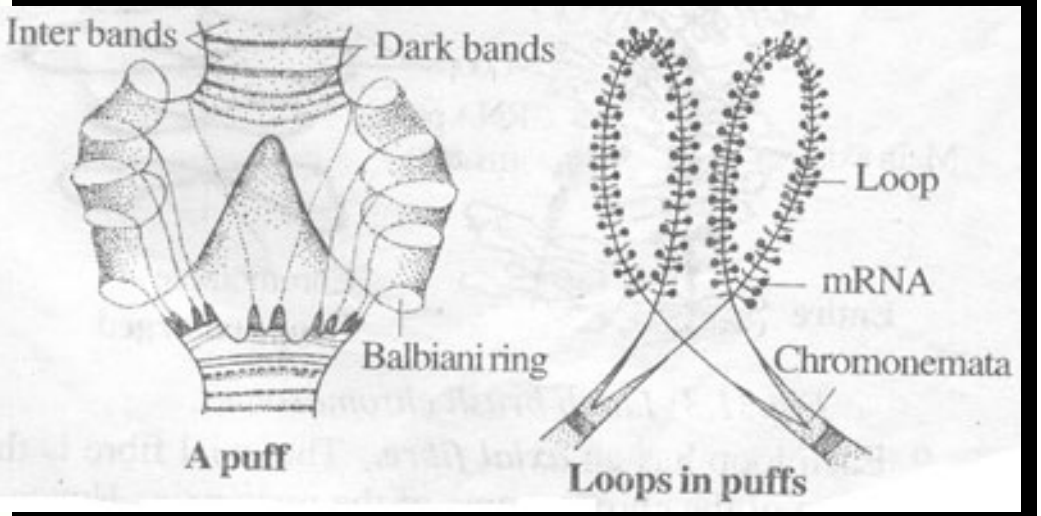
POLYTENE CHROMOSOME

- Genes in the less compact interbands being expressed more highly than those in the more compact bands

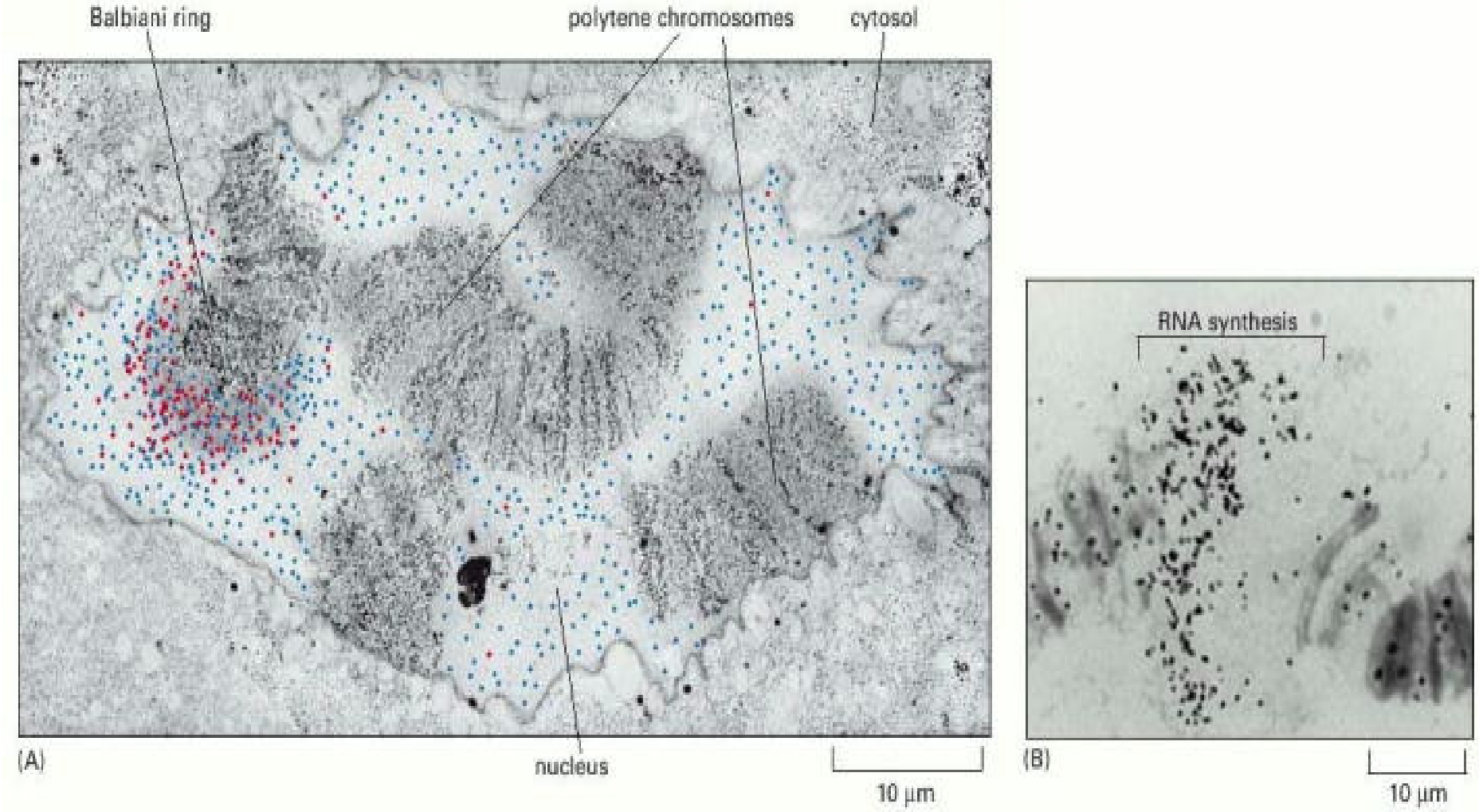
Chromosome puffs

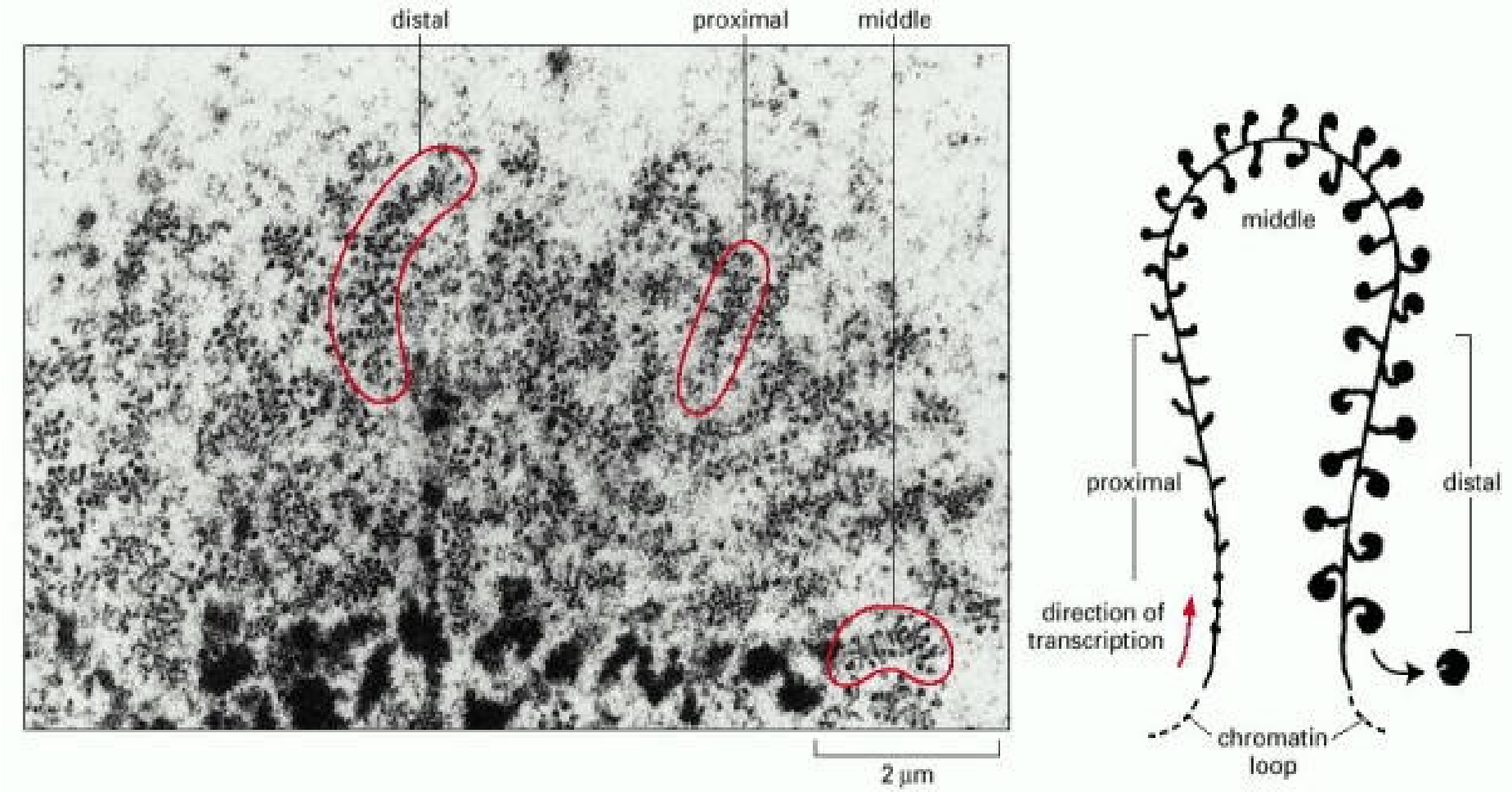


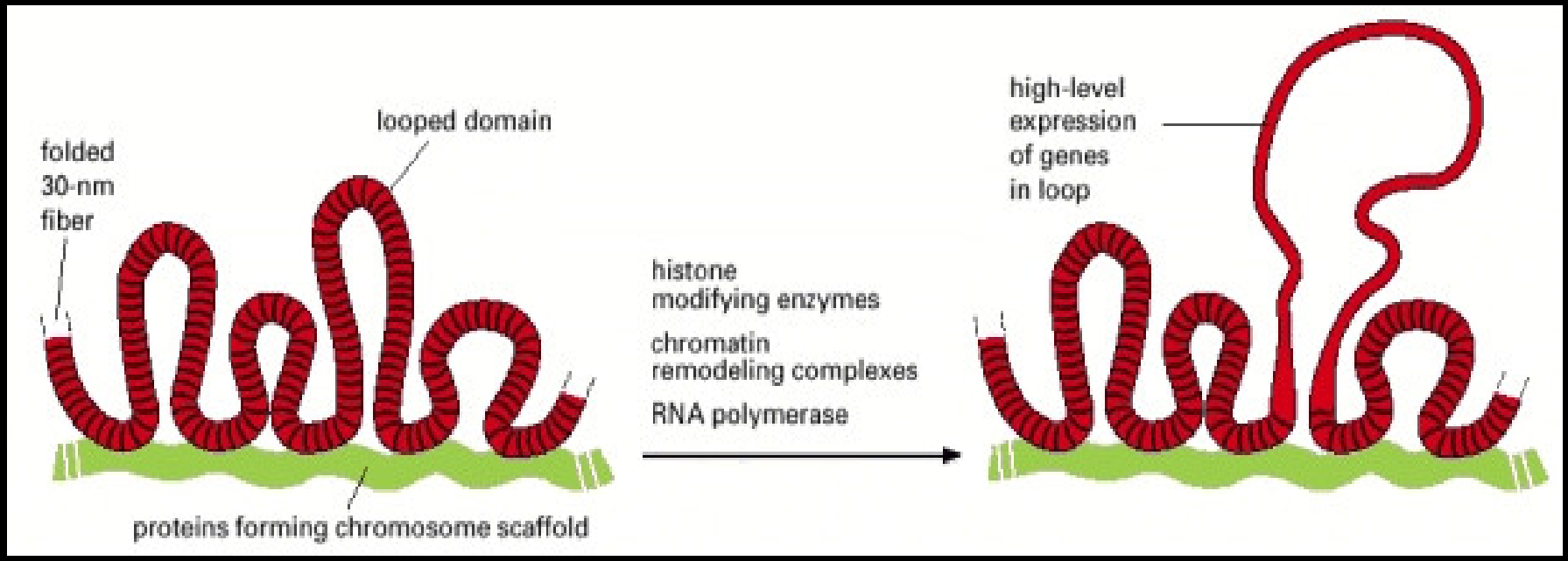
- These are diffuse uncoiled regions of the polytene chromosome that are sites of RNA transcription. A **Balbiani ring** is a large chromosome puff.



GENE EXPRESSION




distal
proximal
middle
2 µm
middle
proximal
distal
direction of
transcription
chromatin
loop

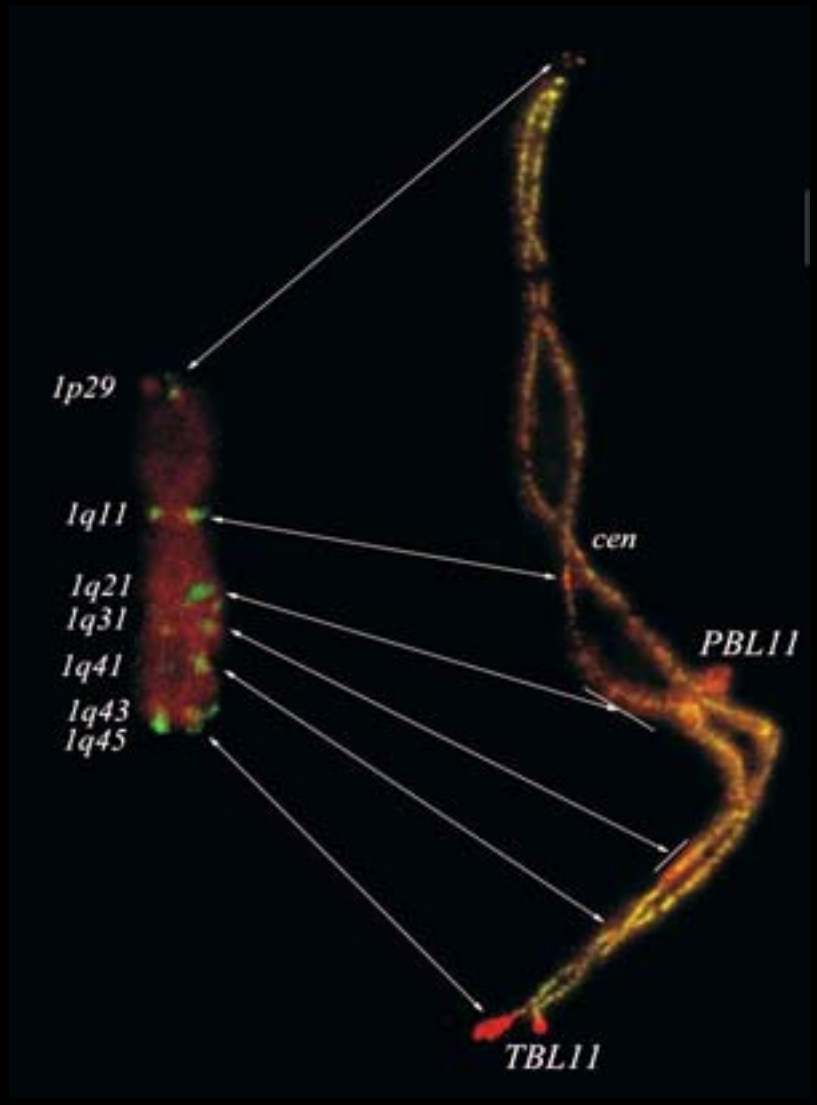

looped domain
folded
30-nm
fiber
proteins forming chromosome scaffold
histone
modifying enzymes
chromatin
remodeling complexes
RNA polymerase
high-level
expression
of genes
in loop

POLYTENE CHROMOSOME

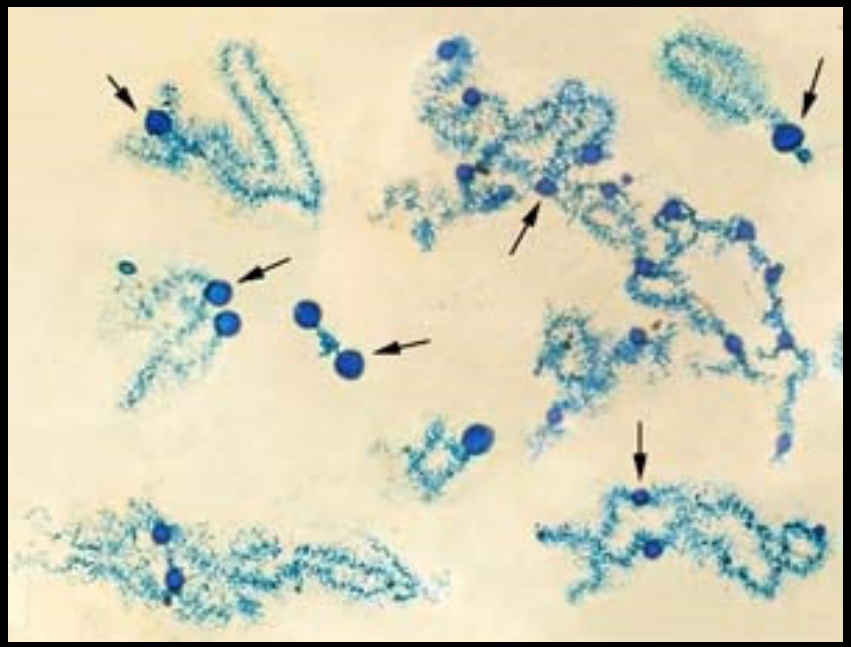
Functions

- metabolic advantage
- multiple copies of genes permits a high level of gene expression
- to identify the species of Chironomid larvae
- to study genetic diversity in species with a wide range

Supernumerary Chromosomes



Lampbrush



Lampbrush chromosomes (LBCs) were **first seen** in sections of salamander (*Ambystoma mexicanum*) oocytes **by Flemming in 1882.**

Ten years later they were **described** in the oocytes of a dogfish by Ruckert (1892). The name lampbrush comes from Ruckert, who likened the objects to a 19th Century lampbrush, equivalent to the 20th Century test-tube brush.

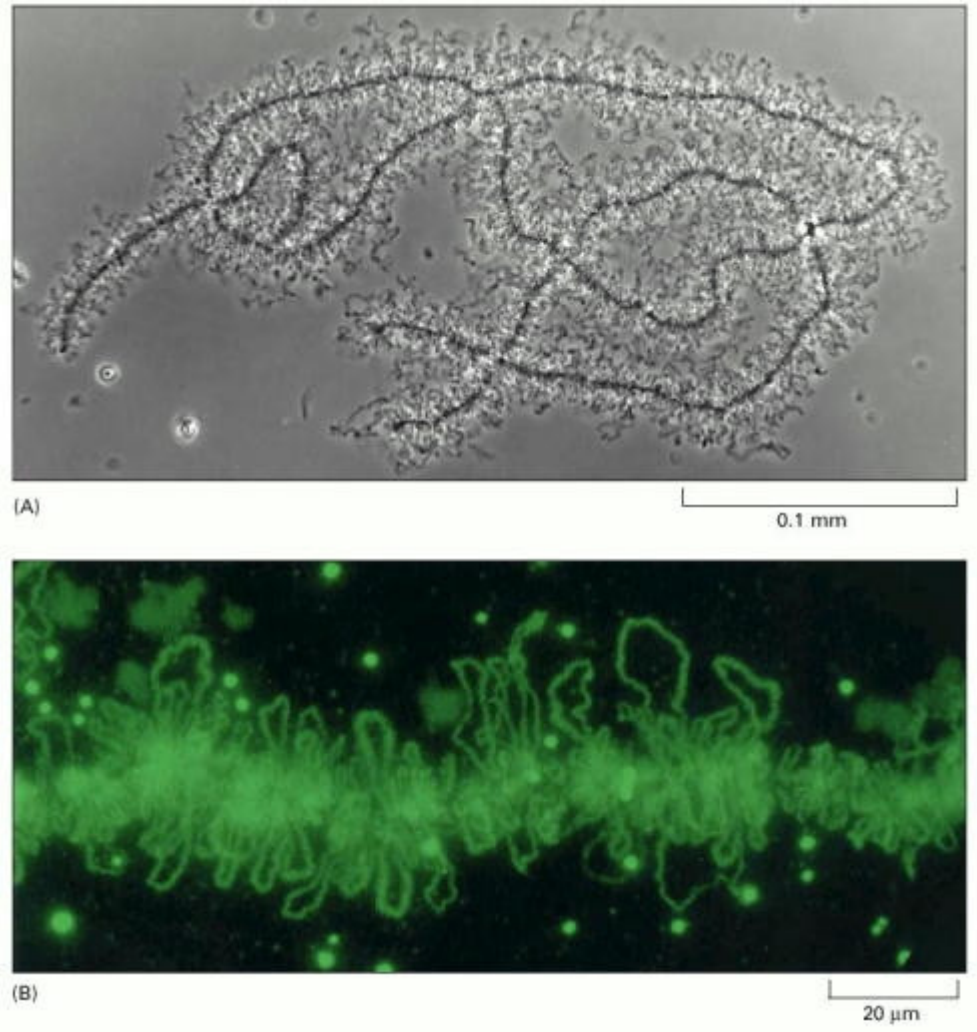
LBCs are **transitory structures** that exist during an extended diplotene of the first meiotic division in females gametocytes of most animals, except mammals.

The chromosomes go from a compact telophase form at the end of the last oogonial mitosis, become lampbrushy and then contract again to form normal first meiotic metaphase bivalents.

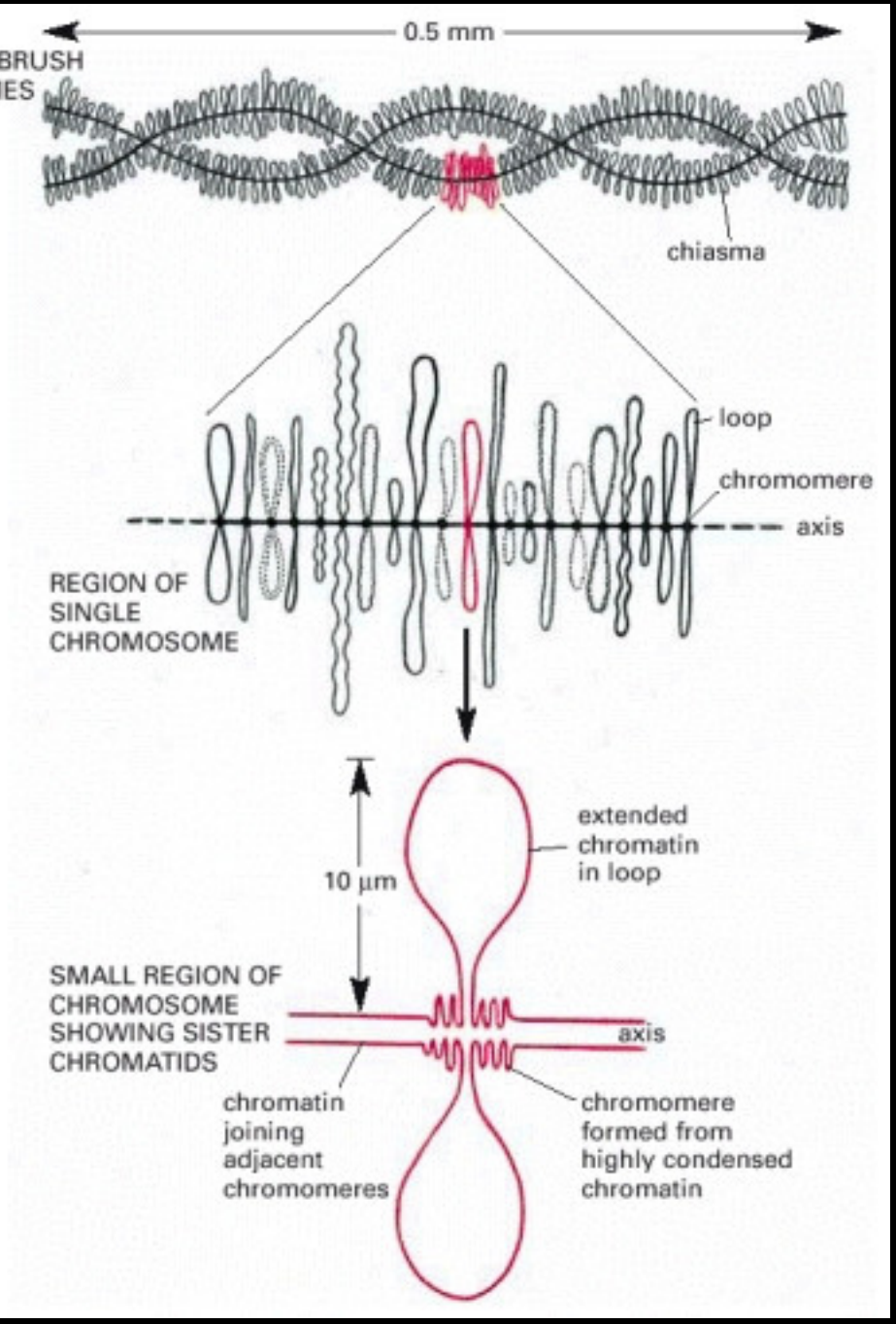
Their most conspicuous feature is widespread RNA transcription from thousands of transcription units that are arranged at short intervals along the lengths of all the chromosomes.

In these senses it has been possible to exploit LBCs in the study of chromosome organization and gene expression during meiotic prophase, and in studies of the molecular and supramolecular morphology of RNA transcription.

LAMP BRUSH CHROMOSOMES

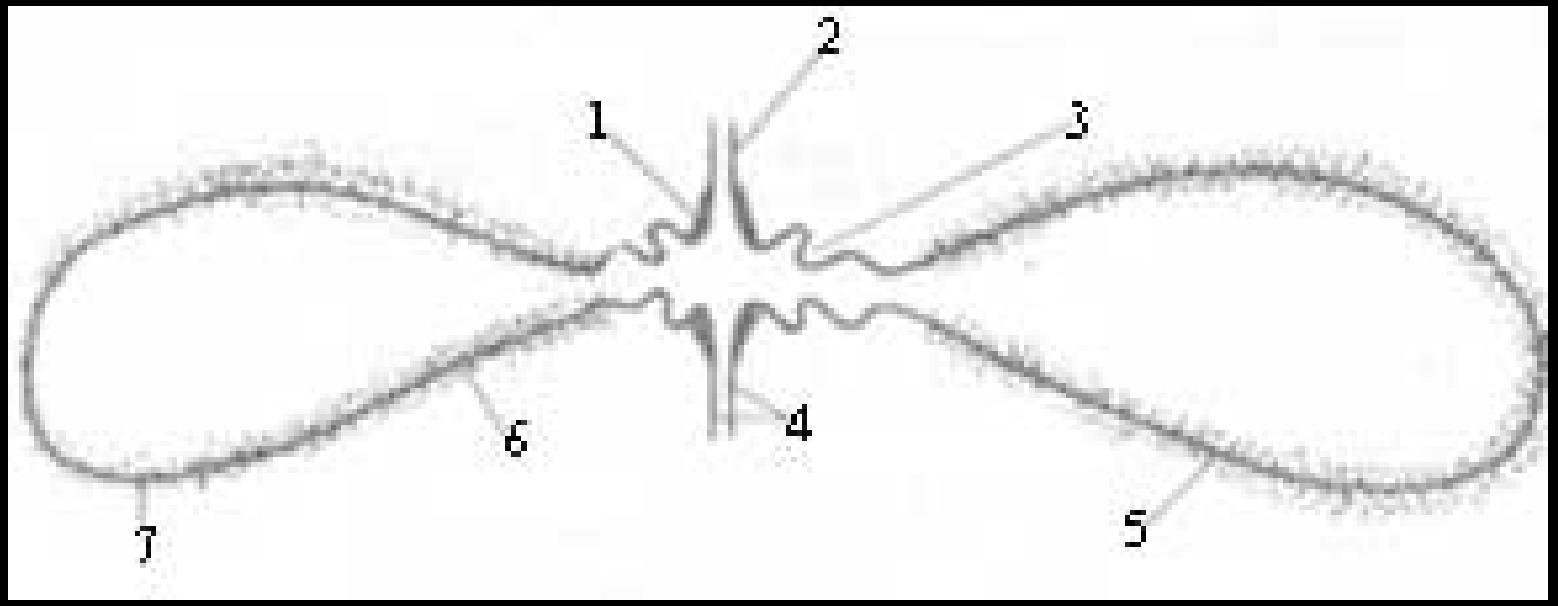


1. It was discovered by Ruckert in 1892.
2. It contains lateral loops and appears like a brush. Hence the name lamp brush chromosomes.
3. It is found in the oocytes of *Sagitta, Sepia, Echinaster* (Echinoderm), insects, sharks, amphibians, reptiles, and birds.
4. It is giant chromosome. It is larger in size. Hence it is called a giant chromosome.

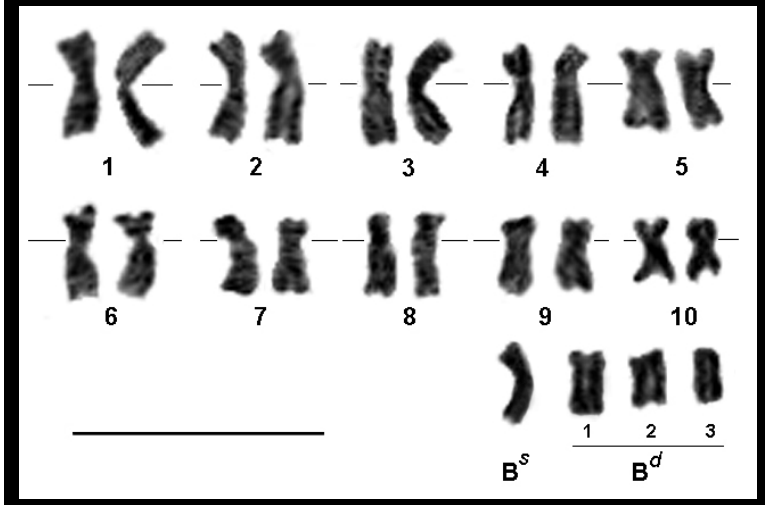


5. Each lamp brush chromosome consists of a main axis and many lateral loops.
6. The main axis of each chromosome is formed of 4 chromatids.
7. The main axis contains a series of thickenings called chromomere.
8. From each chromomere a pair of lateral loops one on each side.
9. Each loop has an axial fibre. The axial fibre is the continuation of the chromonema of the main axis. Hence it contains DNA.
10. The axial fibre of the loop is surrounded by a matrix. The matrix is formed gives a fuzzy appearance.
11. The synthesis of proteins and yolk takes in the lateral loops

1. Chromomere 2. Chromosomes Axis
3. Thin Insertion 4. Chromatids
5. RNA + Protein 6. Matrix 7. Chromonemal

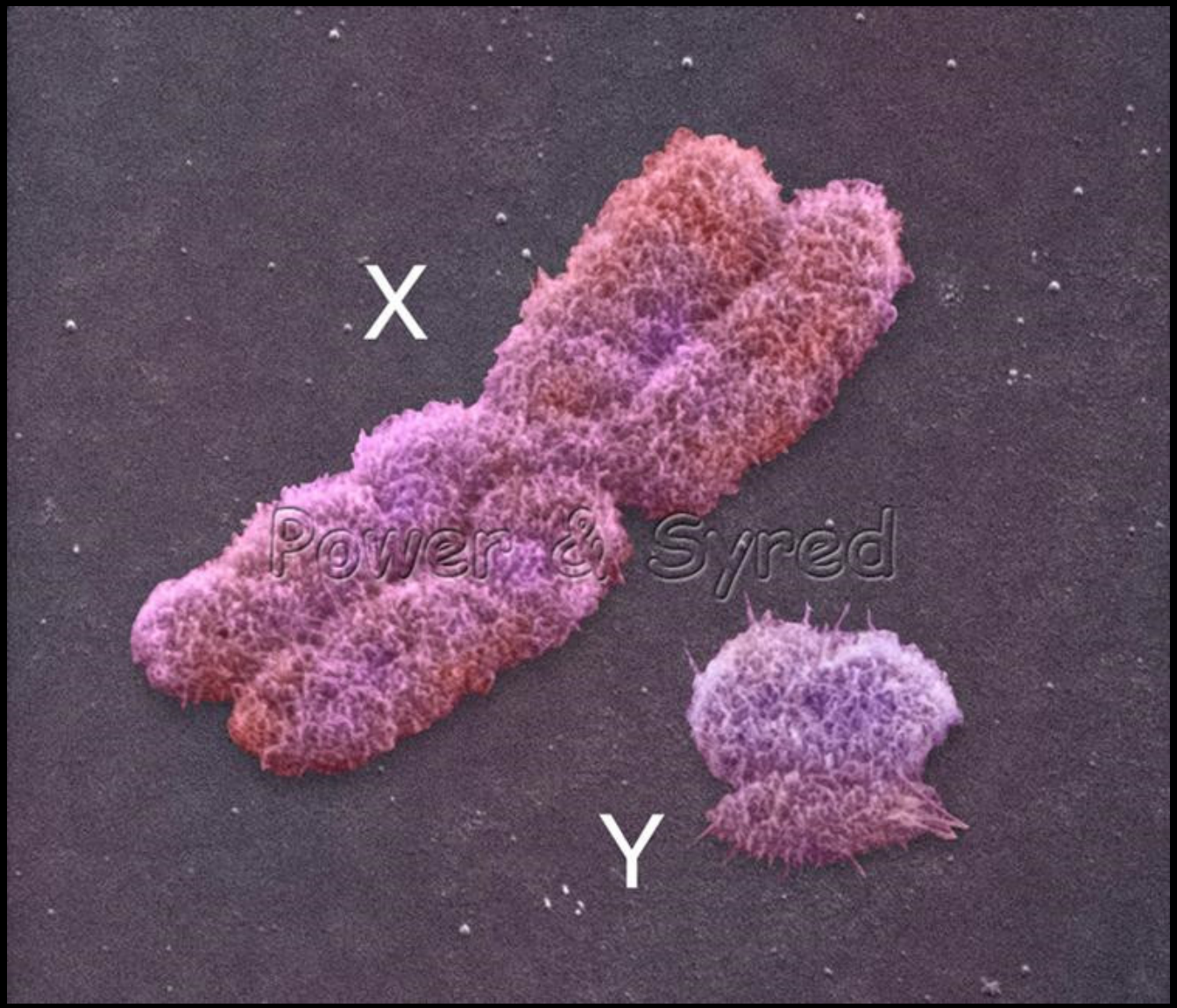


B CHROMOSOMES



1. In addition to the normal karyotype, wild populations of many animal, plant, and fungi species
2. These chromosomes are not essential for the life of a species, and are lacking in some (usually most) of the individuals.
3. Thus a population would consist of individuals with 0, 1, 2, 3 (etc.) supernumeraries
4. B chromosomes have tendency to accumulate in meiotic cell products resulting in an increase of B number over generations

SEX CHROMOSOMES

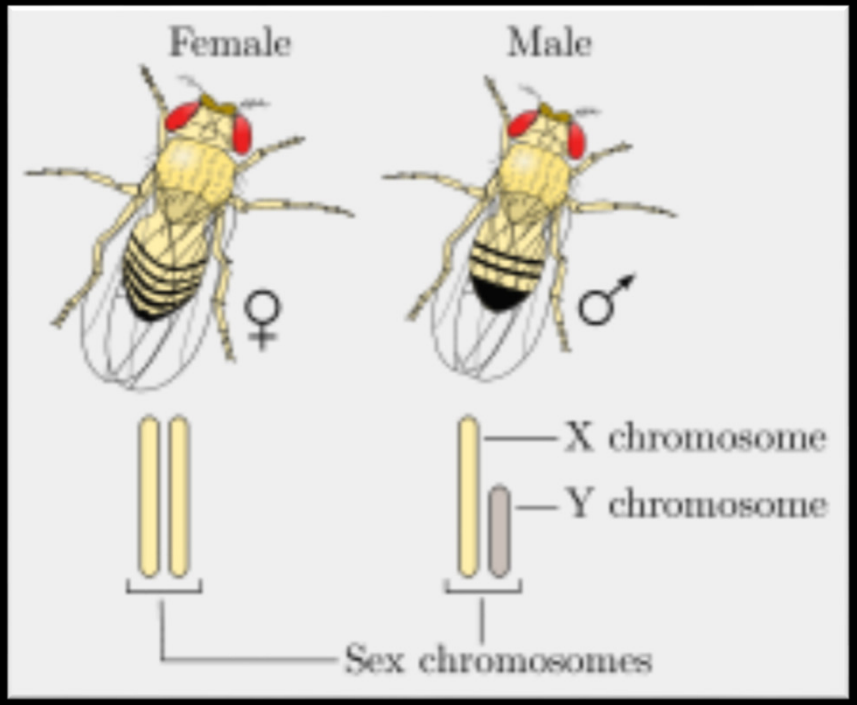


SEX CHROMOSOMES

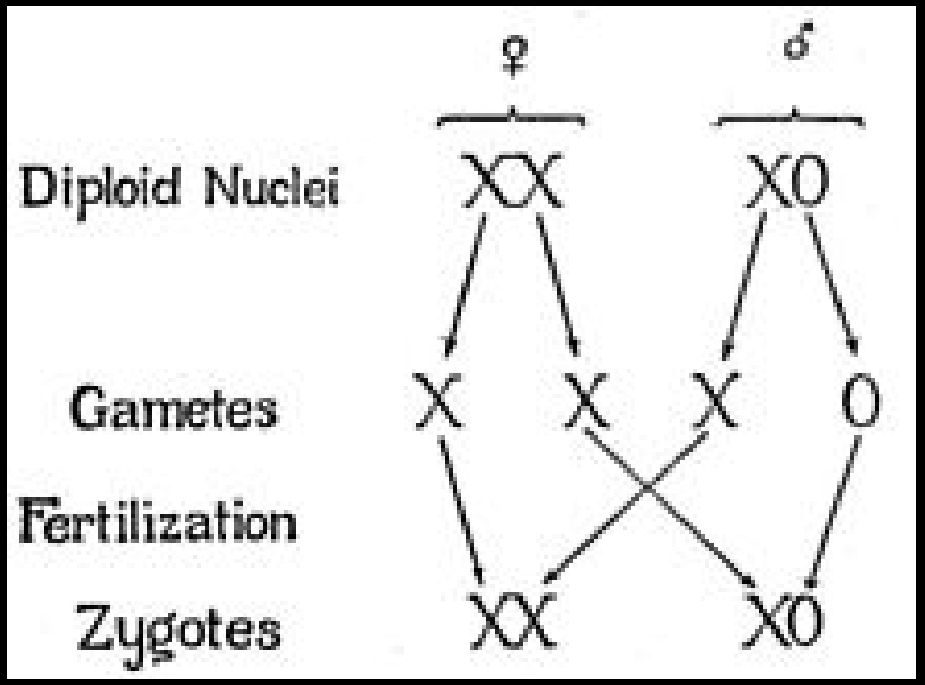
1. A **sex-determination system** is a biological system that determines the development of sexual characteristics in an organism.

2. Determination genetically is generally through chromosome combinations of XY, ZW, XO, ZO, or haplodiploid.

3. Sexual differentiation is generally started by a main gene, a sex locus, then a multitude of other genes follow in a domino effect

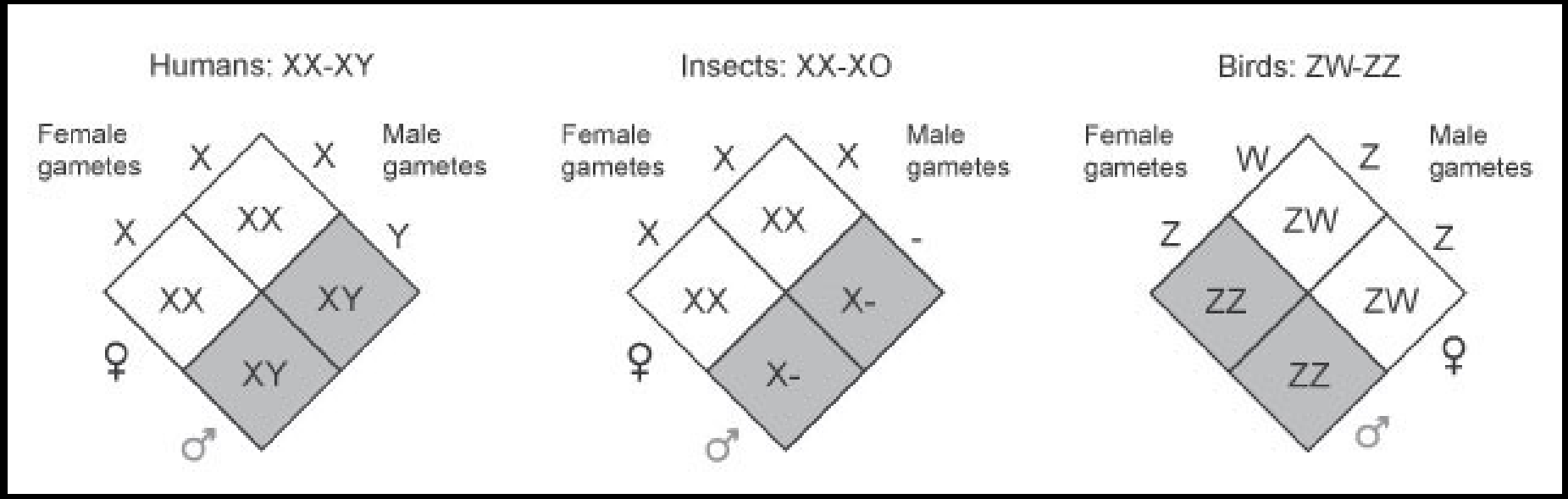


Drosophila sex-chromosomes



Heredity of sex chromosomes in XO sex determination

Haplodiploidy is found in insects belonging to Hymenoptera, such as ants and bees. Unfertilized eggs develop into haploid individuals, which are the males. Diploid individuals are generally female but may be sterile males.

Males cannot have sons or fathers. If a queen bee mates with one drone, her daughters share ¾ of their genes with each other, not ½ as in the XY and ZW systems.

The **ZW sex-determination system** is found in birds, some reptiles, and some insects and other organisms. The ZW sex-determination system is reversed compared to the XY system: females have two different kinds of chromosomes (ZW), and males have two of the same kind of chromosomes (ZZ).