CHROMOSOMAL STRUCTURAL ABERRATIONS

INSTITUTE OF BIOLOGY AND MEDICAL GENETICS
OF THE 1ST FACULTY OF MEDICINE

CHROMOSOMAL ABERRATIONS

- NUMERICAL
- STRUCTURAL
  - BALANCED
  - UNBALANCED
- MIXOPLOIDY
  - MOSAICISM
  - CHIMERISM

STRUCTURAL CHROMOSOME REARRANGEMENTS

BALANCED (PHENOTYPICALLY HARMLESS):

INVERSION

TRANSLOCATION

INSERTION

UNBALANCED:

DELETION

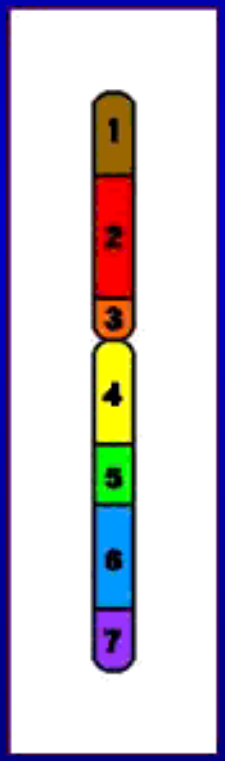
DUPLICATION

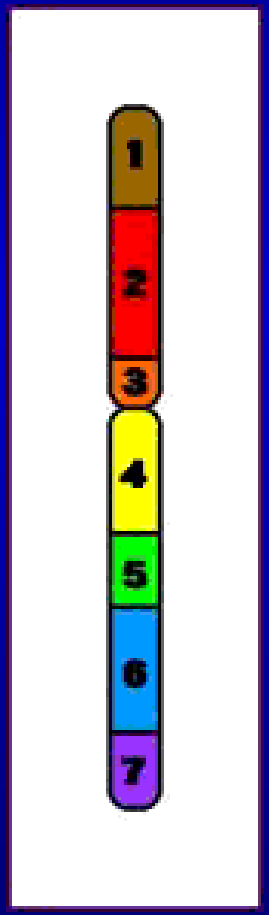
ISOCHROMOSOME

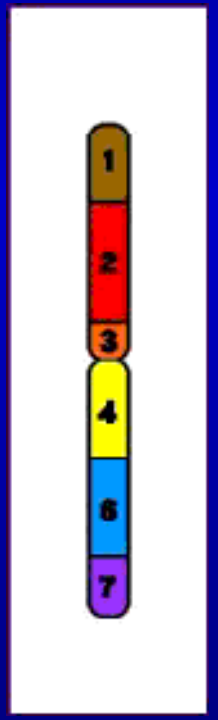
RING CHROMOSOME

DICENTRIC CHROMOSOME

DELETION
INTERSTITIAL

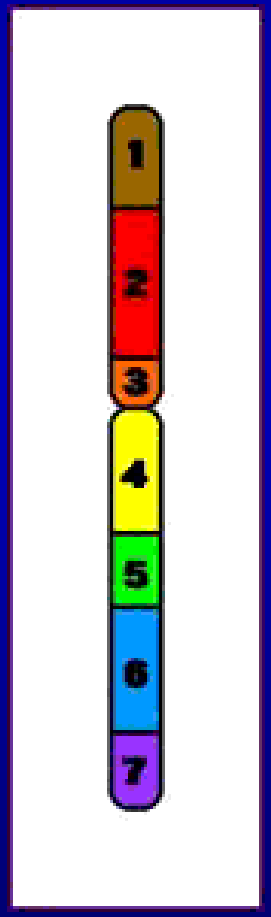






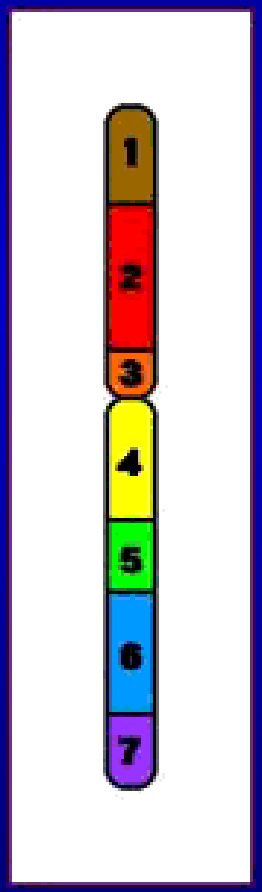
DELETION

TERMINAL



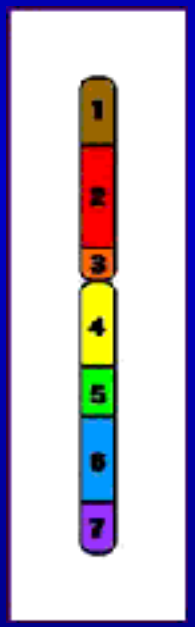
INVERSION

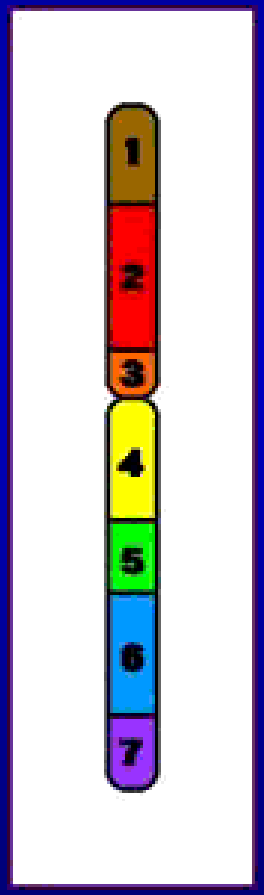
PARACENTRIC

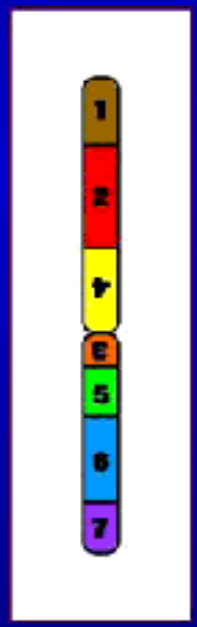


INVERSION

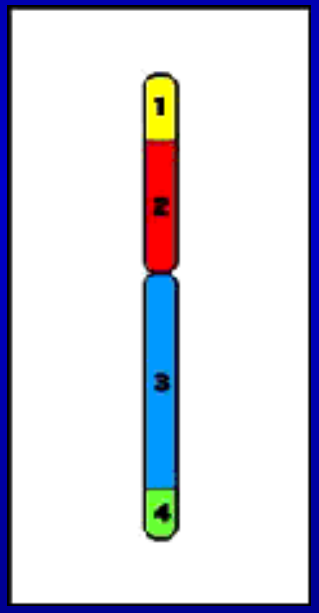
PERICENTRIC

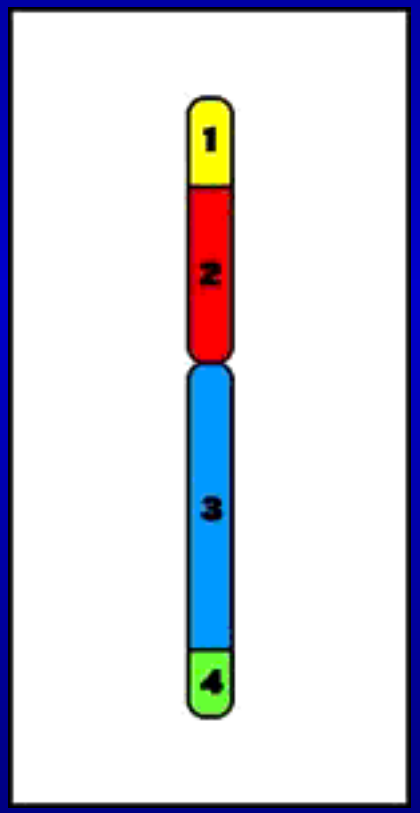


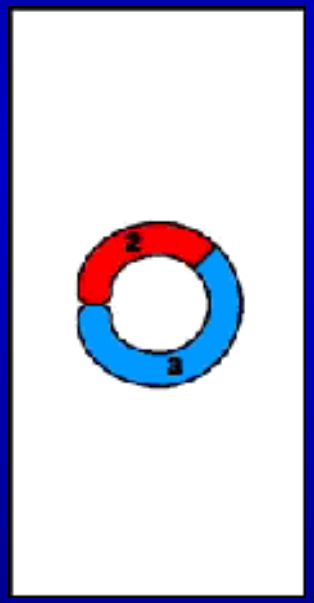




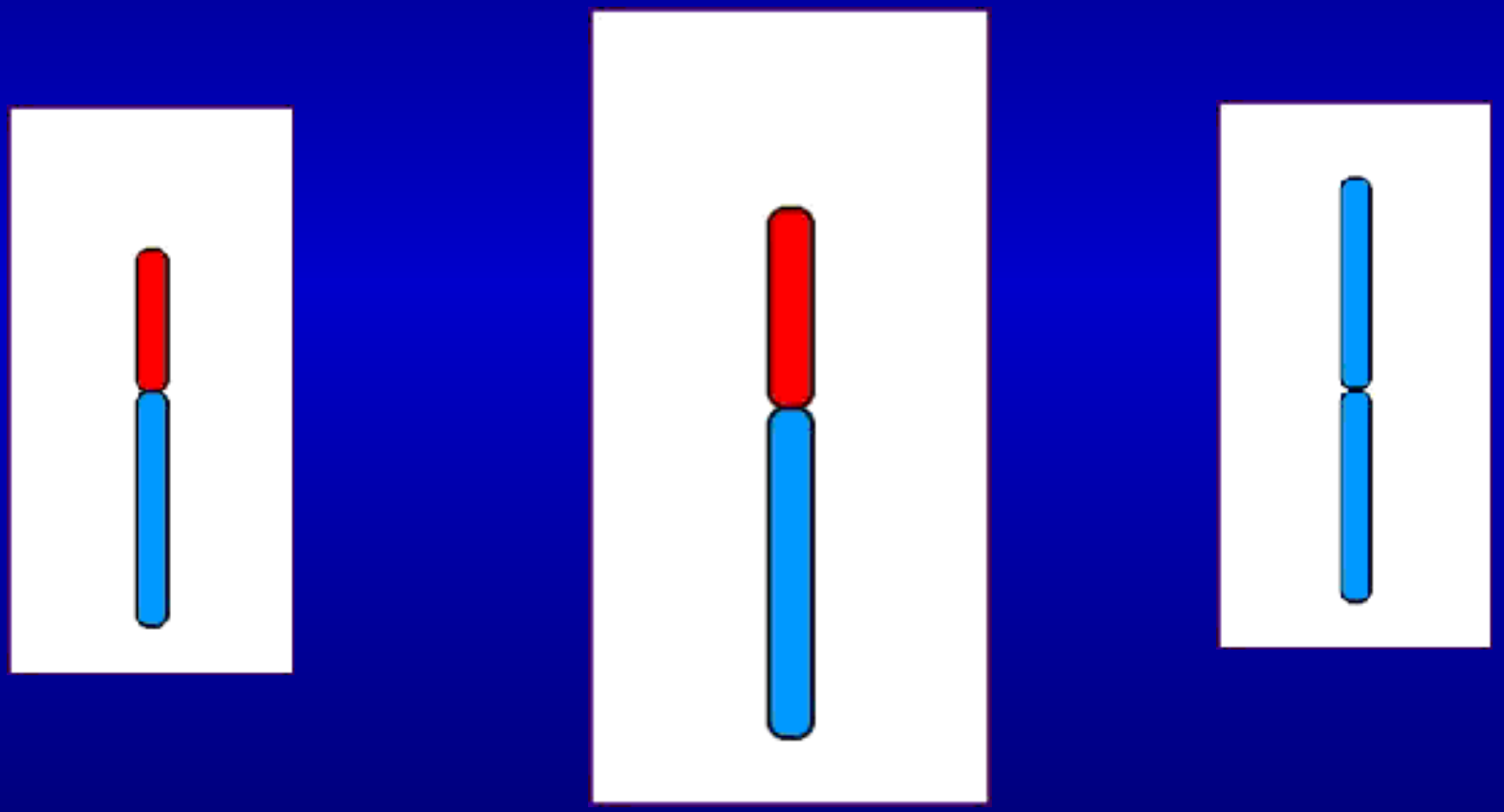
RING CHROMOSOME





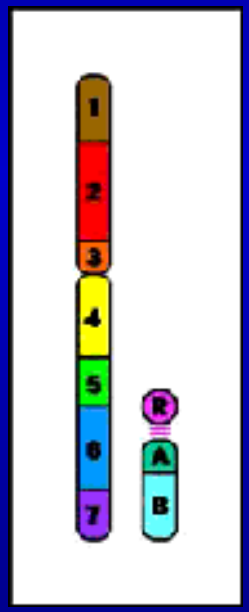


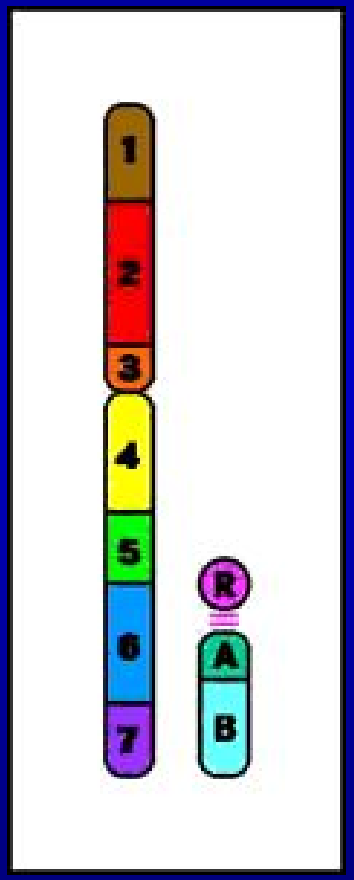
ISOCHROMOSOME



TRANSLOCATION

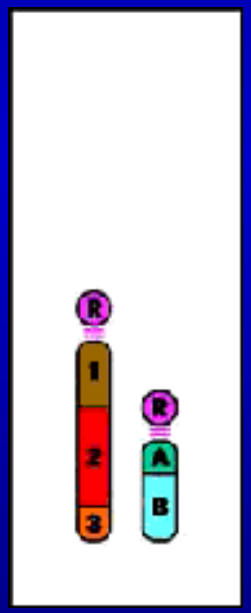
RECIPROCAL

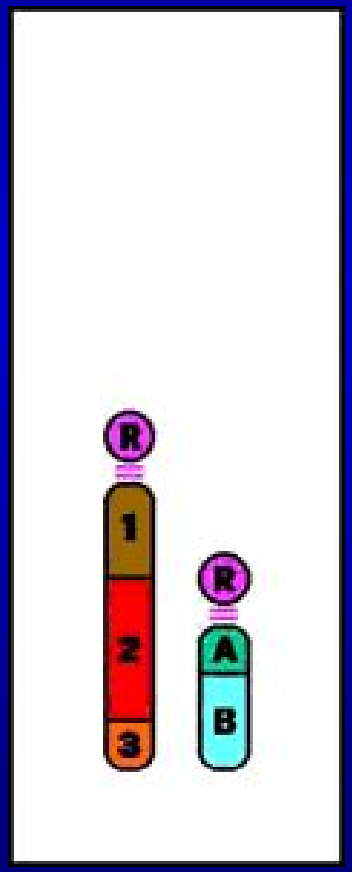


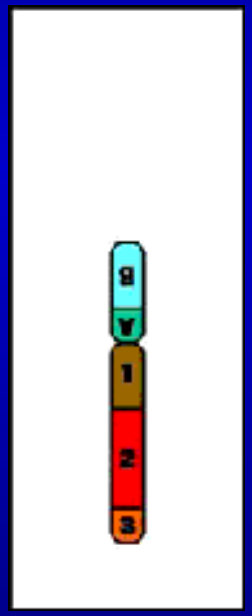


TRANSLOCATION

ROBERTSONIAN (CENTRIC FUSION)







INTERNATIONAL CYTOGENETIC NOMENCLATURE ISCN – 2005, 2009

(examples of symbols and abbreviations)

Normal human karyotype: 46, XX or 46, XY

Numerical aberrations: 47, XXY; 45, X; 69, XXY

+/- placed before additional or missing chromosome 47, XX, +21

Structural aberrations:

del - deletion 46, XY, del(5)(p?) 46, X, del(X)(q?)

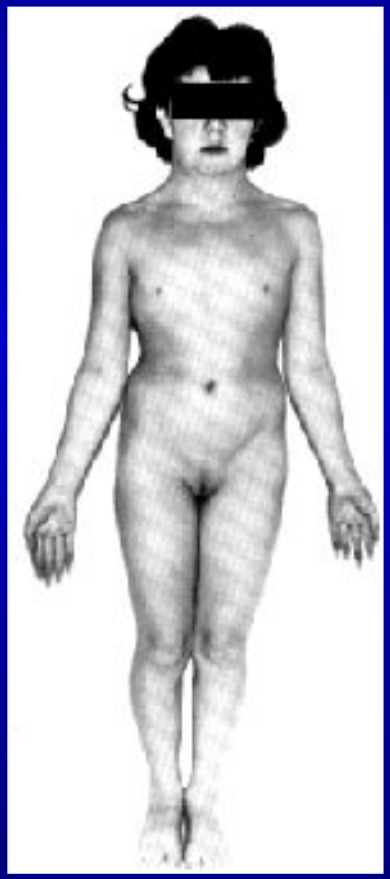
t - translocation (reciprocal) 46, XY, t(2;8)(p?;q?)

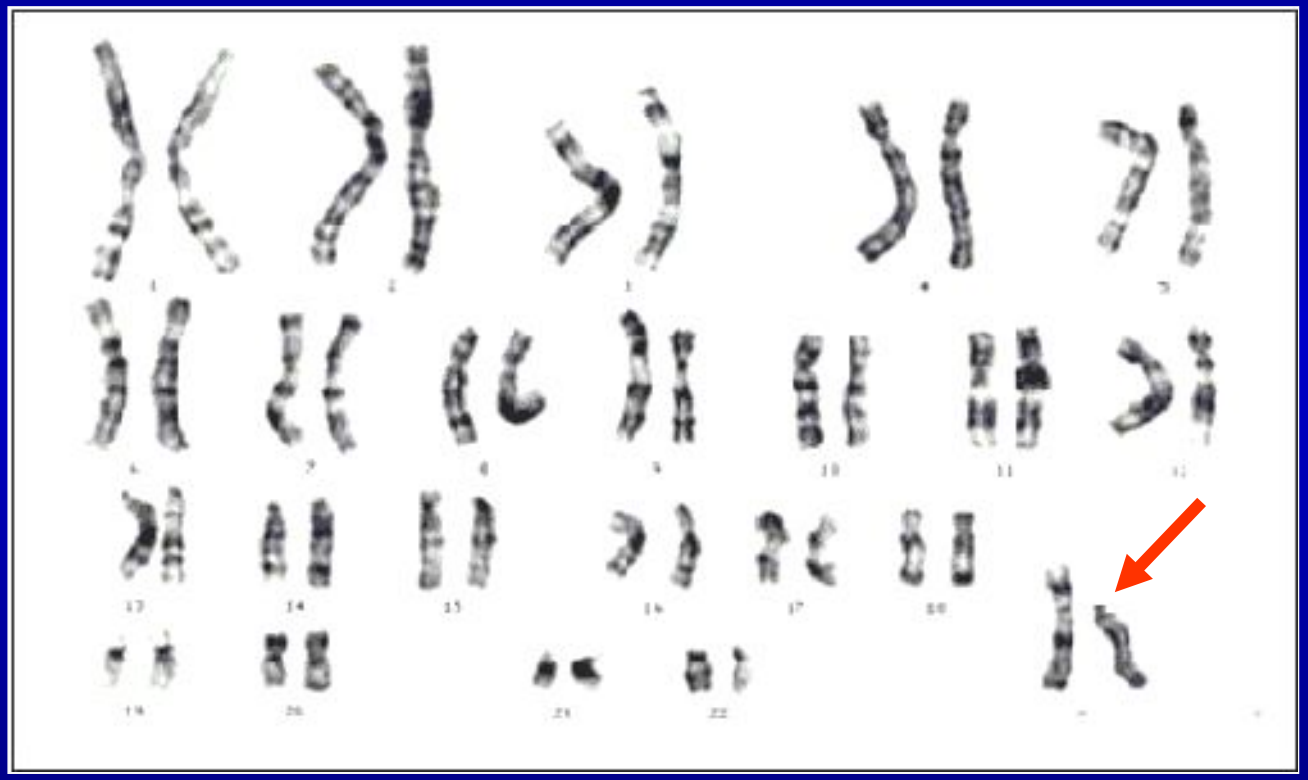
der, rob - derivative chromosome (Robertsonian translocation)

45, XX, der(14;21) n. 45, XX, rob(14;21)

46, XY, der(21;21), +21 n. 46, XY, rob(21;21), +21

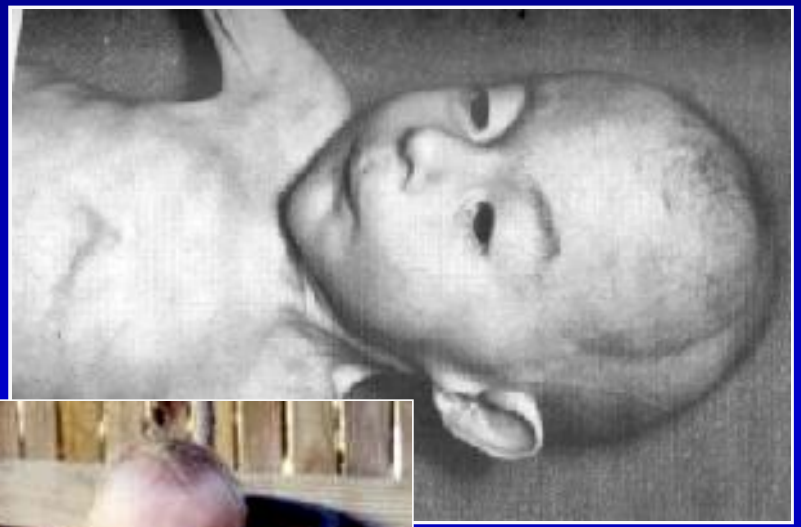
TURNER SYNDROME
DELETION FORM





46,X,del(Xp)

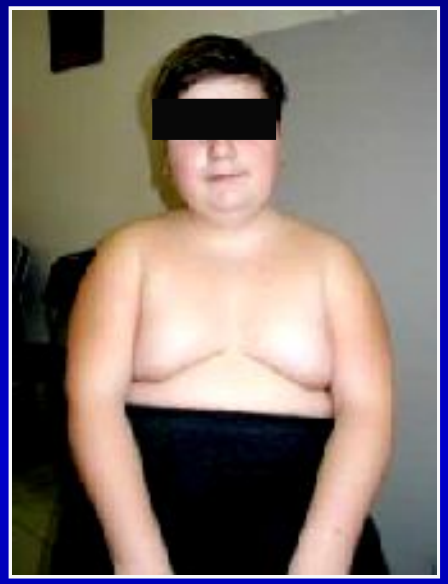
CRI DU CHAT SYNDROME
(CAT CRY SYNDROME)

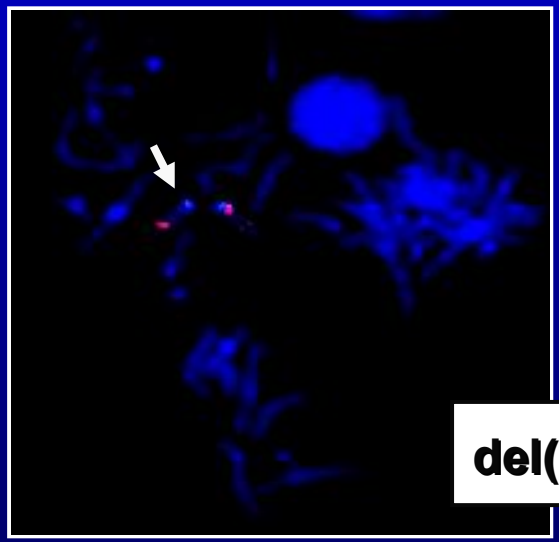


del(5p)

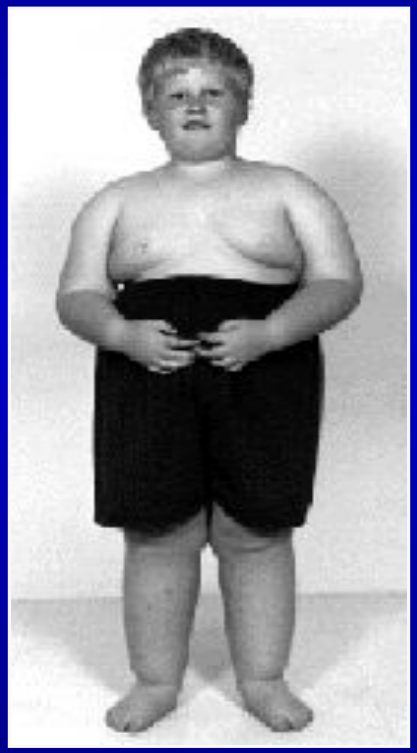
- microcephaly
- severe somatic and mental retardation
- round „moon-shaped" face (in childhood)
- hypoplastic larynx – high shrill cry (like a mewing cat)

PRADER-WILLI SYNDROME





del(15)(q11-13)pat



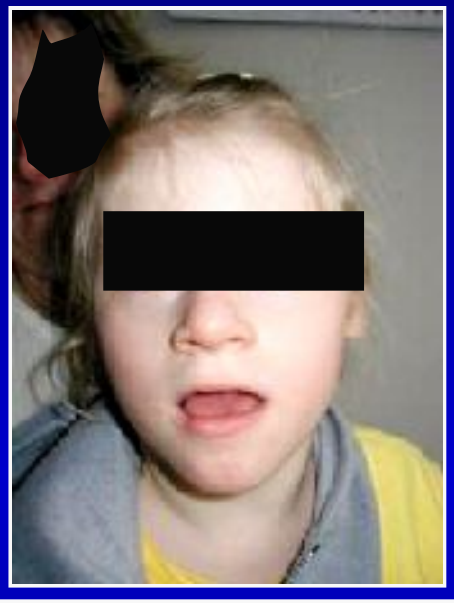
NEWBORNS, EARLY INFANTS:

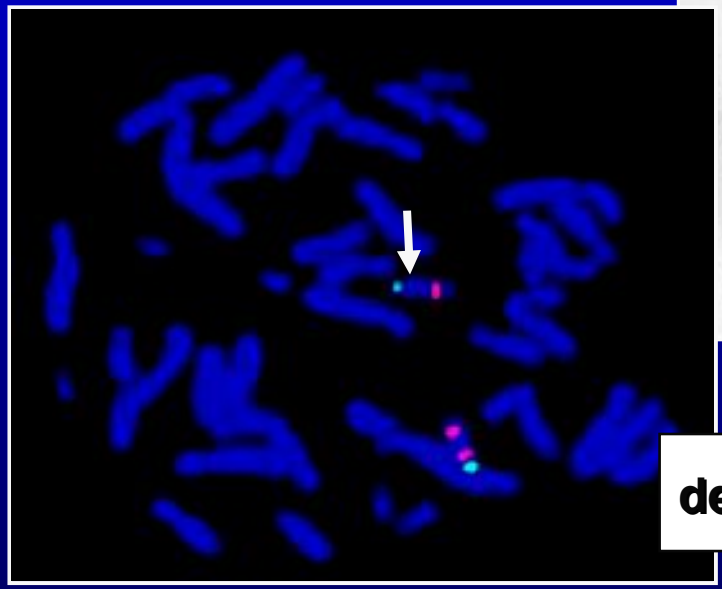
- severe hypotonia
- developmental delay

LATER:

- mental retardation
- overeating – extreme obesity with complications (DM, cardiovascular disorders, sleeplessness,…)
- hypogenitalism
- behavioral disorders

ANGELMAN SYNDROME

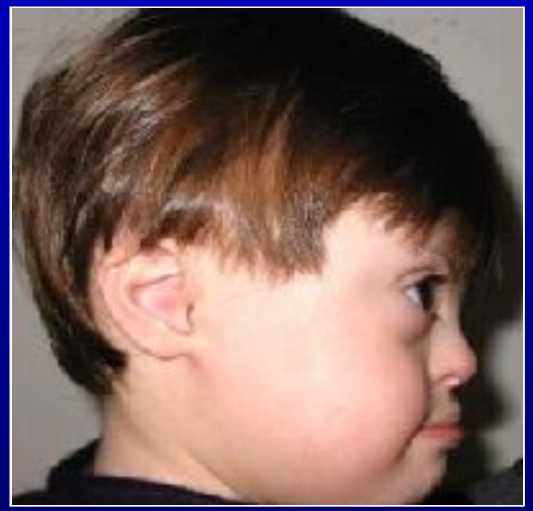




del(15)(q11-13)mat

- severe mental retardation
- absent speech
- paroxysms of easily provoked laughter
- jerky movements, ataxia, stiff-legged gait
- epileptic seizures
- „happy puppet" syndrome

DOWN SYNDROME
TRANSLOCATION FORM



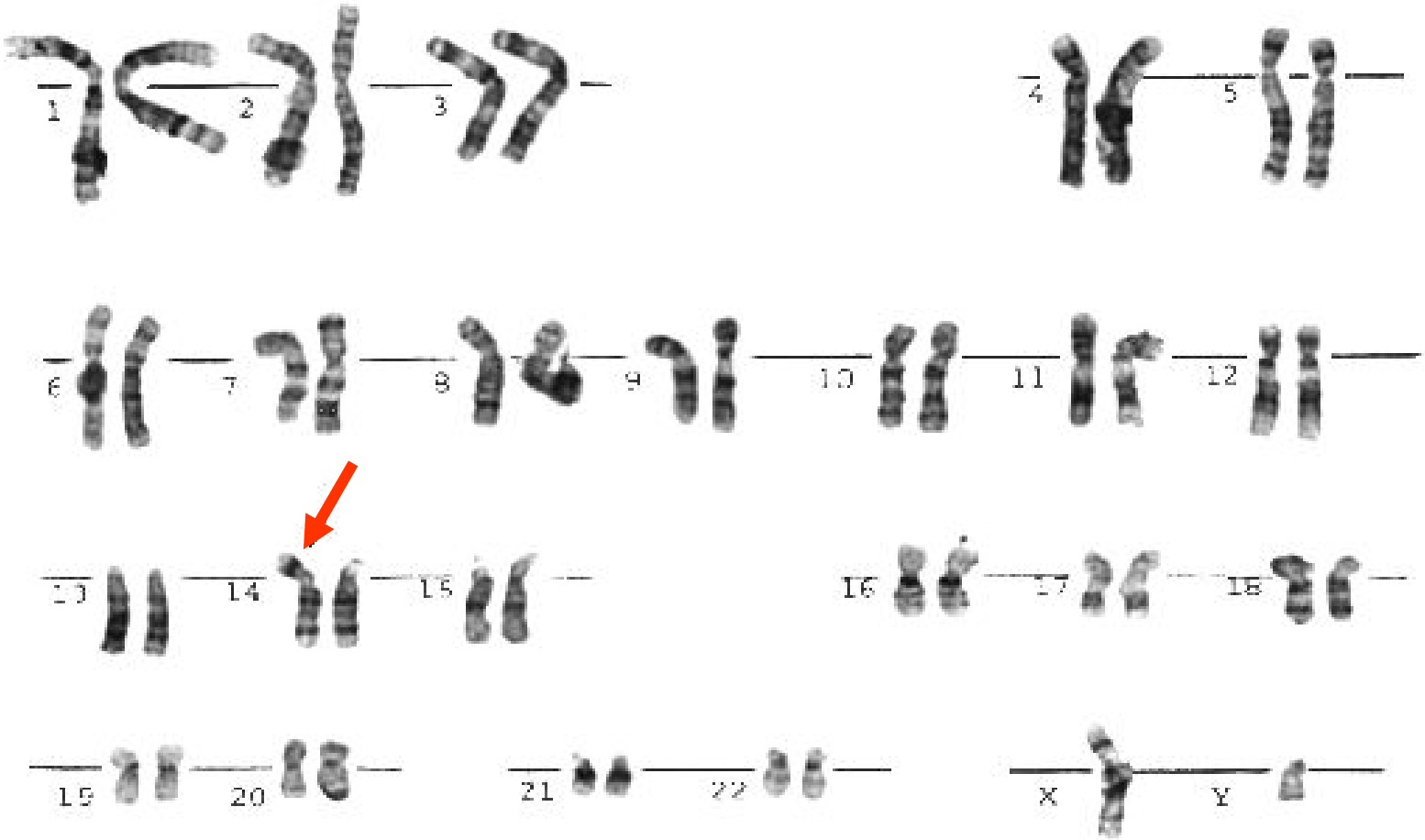
M. DOWN:

95% free trisomy of chr. 21

4-5% translocation form
(Robertsonian translocation)

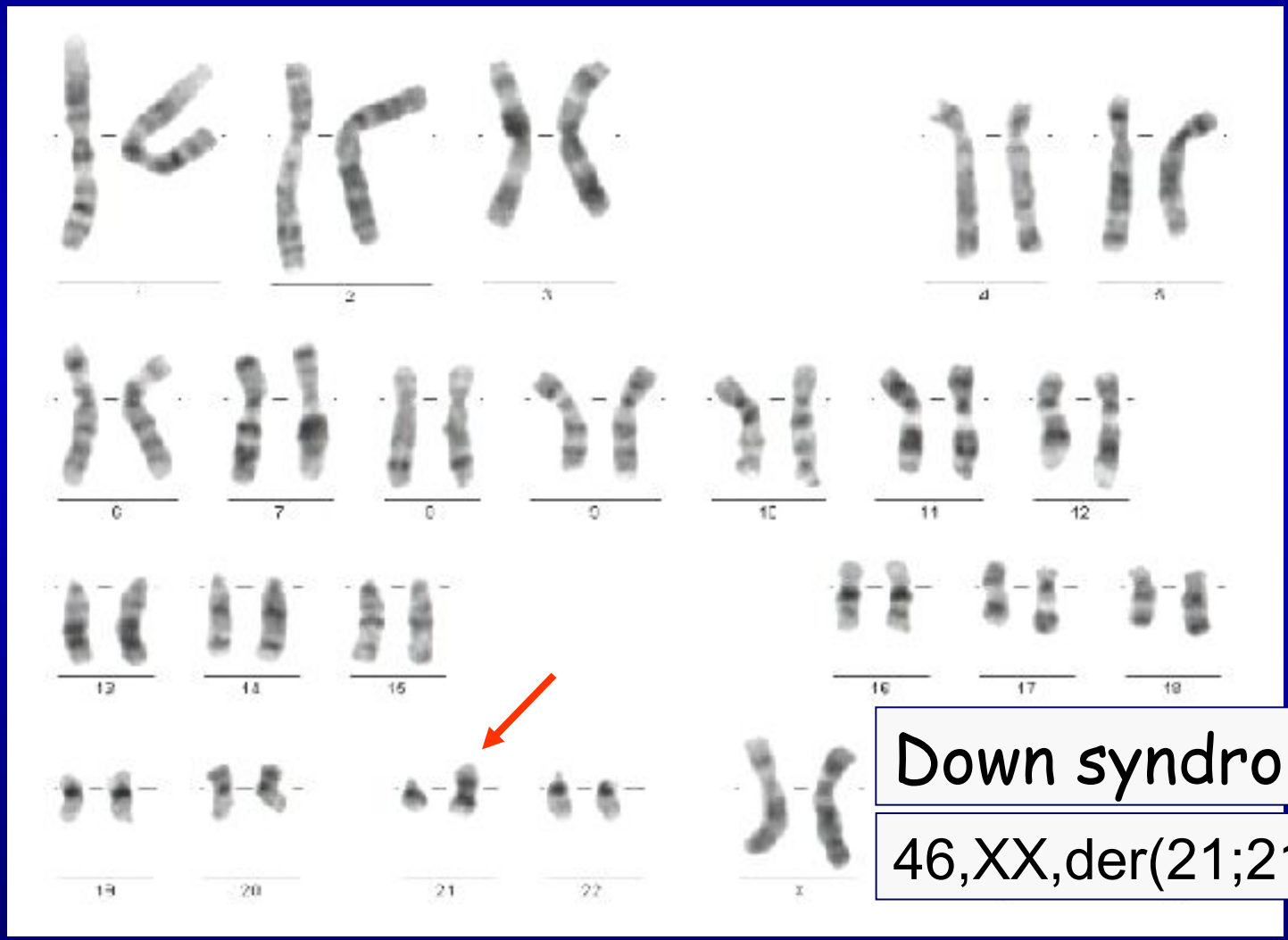
<1% mosaicism

DOWN SYNDROME
TRANSLOCATION FORM



46,XY,der(14;21),+21

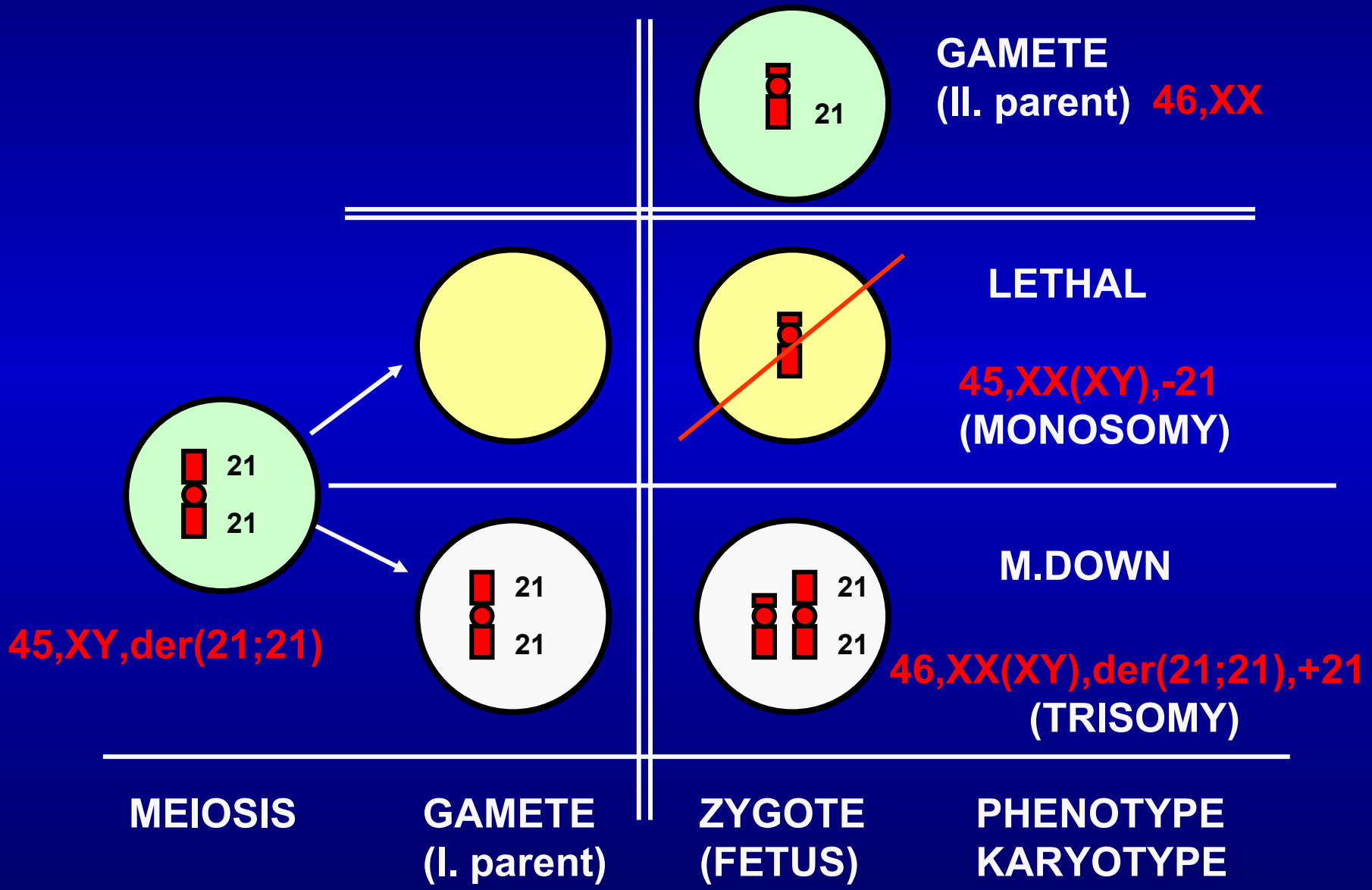
Analyse the karyotype of a newborn with Down syndrome features (task 17, p. 89):



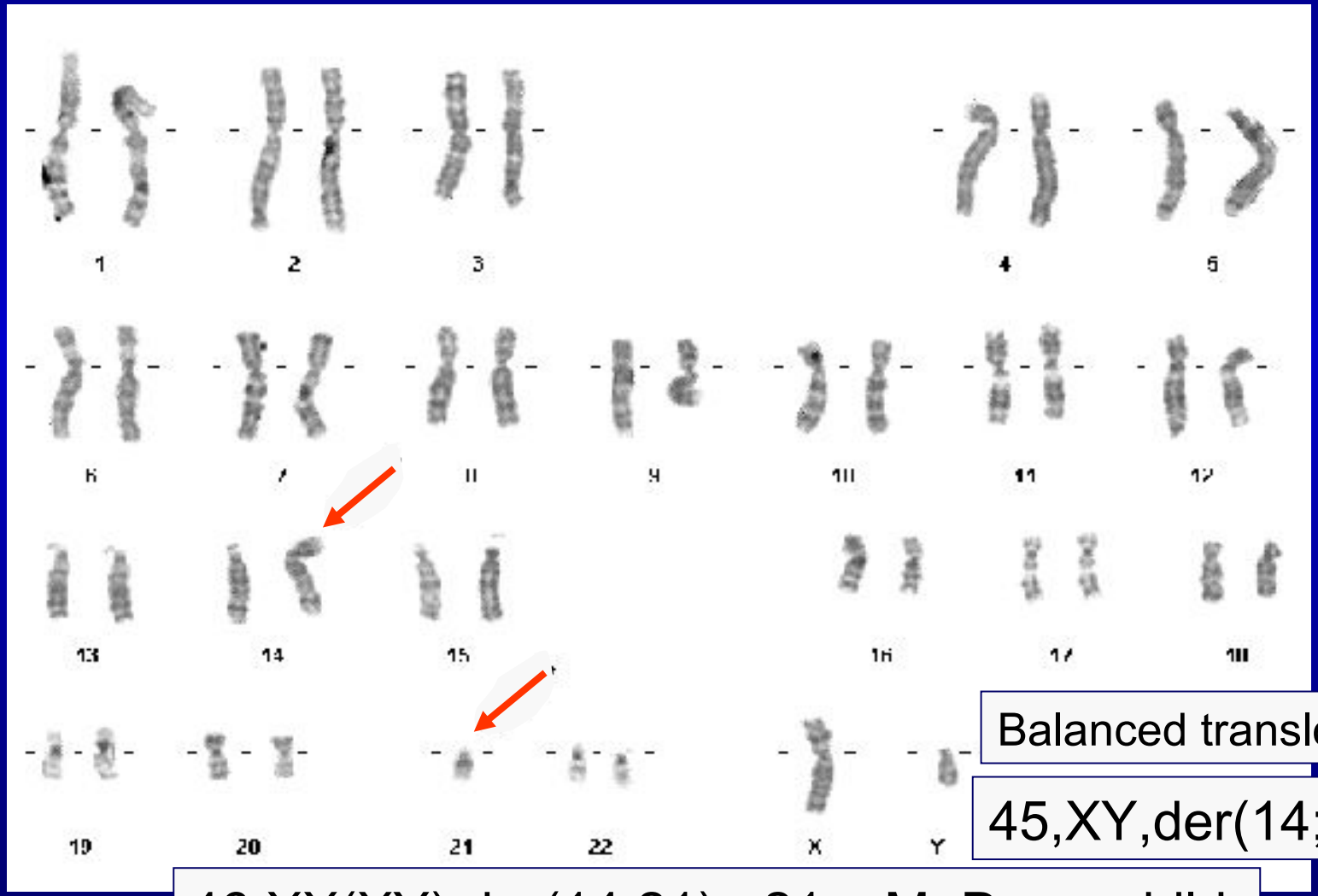
Down syndrome

46,XX,der(21;21),+21

Risk: in theory 100%, empirical 100%



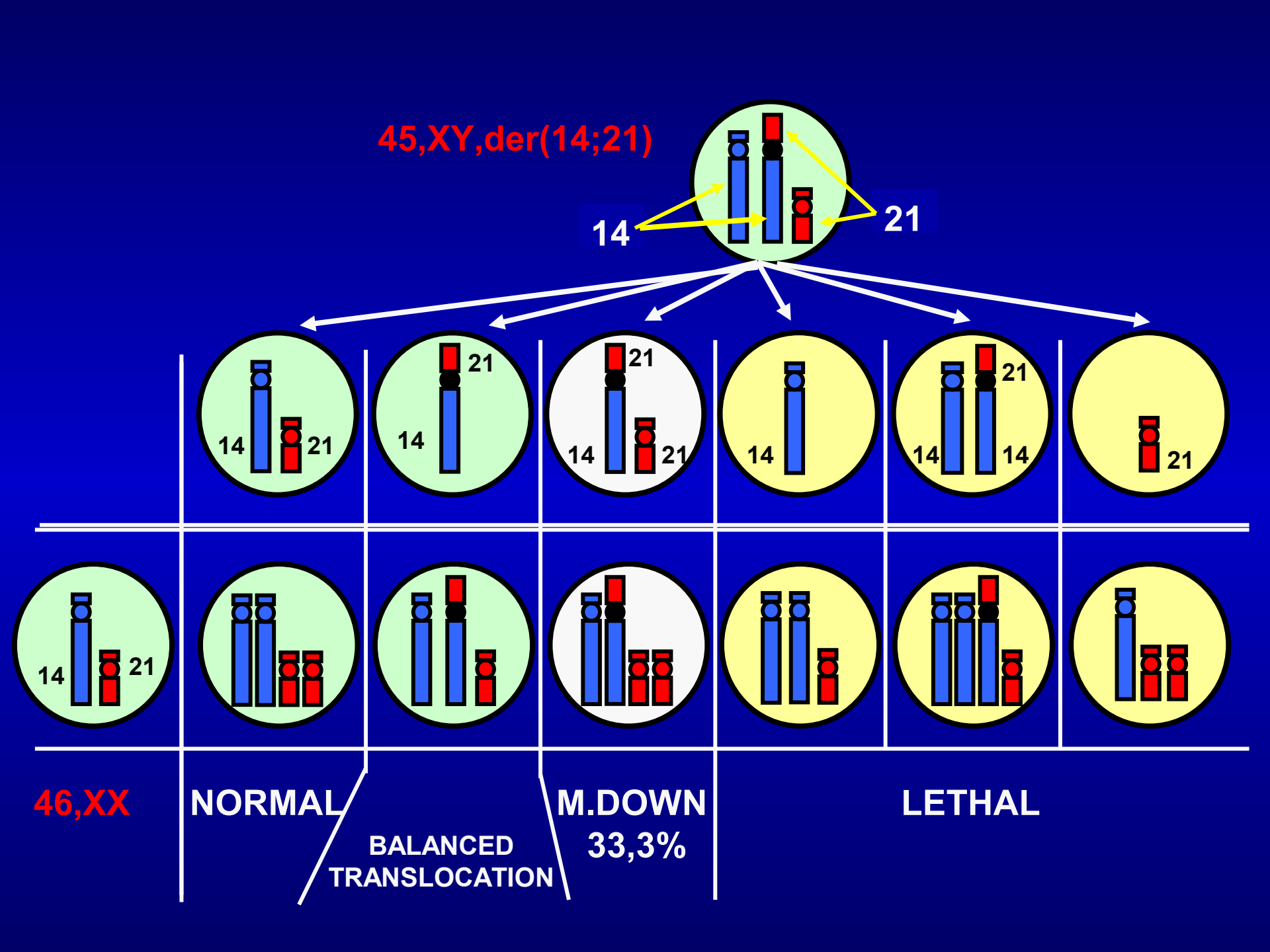
Analyse the karyotype of a man - father of Down syndrome child, mother - 46,XX (task 16, p. 88):



Balanced translocation

45,XY,der(14;21) - father

46,XX(XY),der(14;21),+21 – M. Down child


45,XY,der(14;21)
14
21
14
21
14
21
14
21
21
14
21
14
14
21
14
21
46,XX
NORMAL
BALANCED
TRANSLOCATION
M.DOWN
33,3%
LETHAL

MORBUS DOWN

PROBAND	PARENTS		RISK
47,$X^X/_Y$,+21	46,$X^X/_Y$	46,$X^X/_Y$	> THAN POPULATION dependence on maternal age
46,$X^X/_Y$,der(21;21),+21	45,$X^X/_Y$,der(21;21)	46,$X^X/_Y$	100% THEORETICAL 100% EMPIRICAL
46,$X^X/_Y$,der(D;21),+21 46,$X^X/_Y$+21,der(21;22)	45,$X^X/_Y$,der(D;21) 45,$X^X/_Y$,der(21;22)	46,$X^X/_Y$	33,3% THEORETICAL EMPIRICAL: cca 5% - father (carrier) cca 15% - mother (carrier)
46,$X^X/_Y$,der(D;21),+21 46,$X^X/_Y$,+21,der(21;G)	46,$X^X/_Y$	46,$X^X/_Y$	NEW MUTATION NONPATERNITY
47,$X^X/_Y$,+21	47,$X^X/_Y$,+21/46,$X^X/_Y$	46,$X^X/_Y$	MOSAICISM – depends on ratio of the cell lines with normal and aberrant number of chromosome 21