MENDELIAN GENETICS

MONOHYBRIDISM AND DIHYBRIDISM

1st year, 2nd semester, week 2
Feb 25, 26 and 27, 2008

MONOHYBRIDISM

PARENTAL GENERATION

GENOTYPE

GAMETES

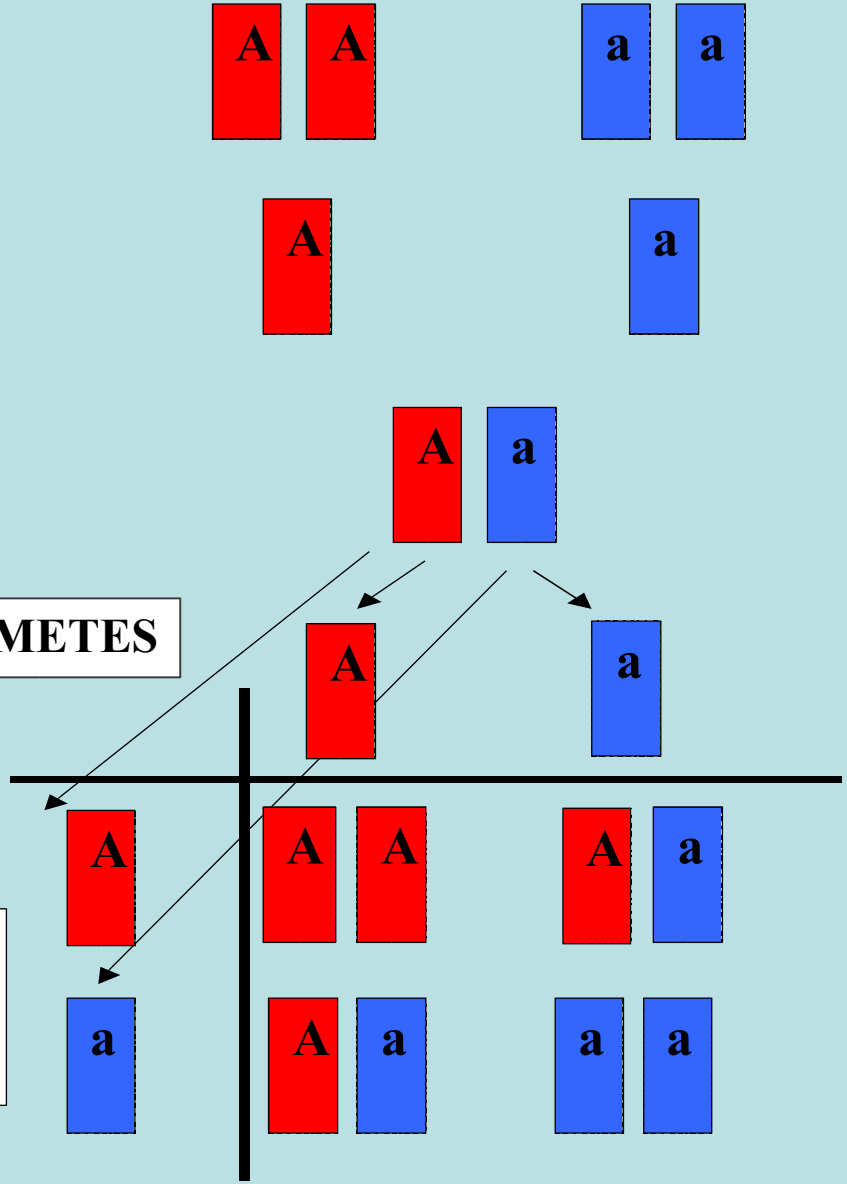
F_1 GENERATION GENOTYPE

GAMETES

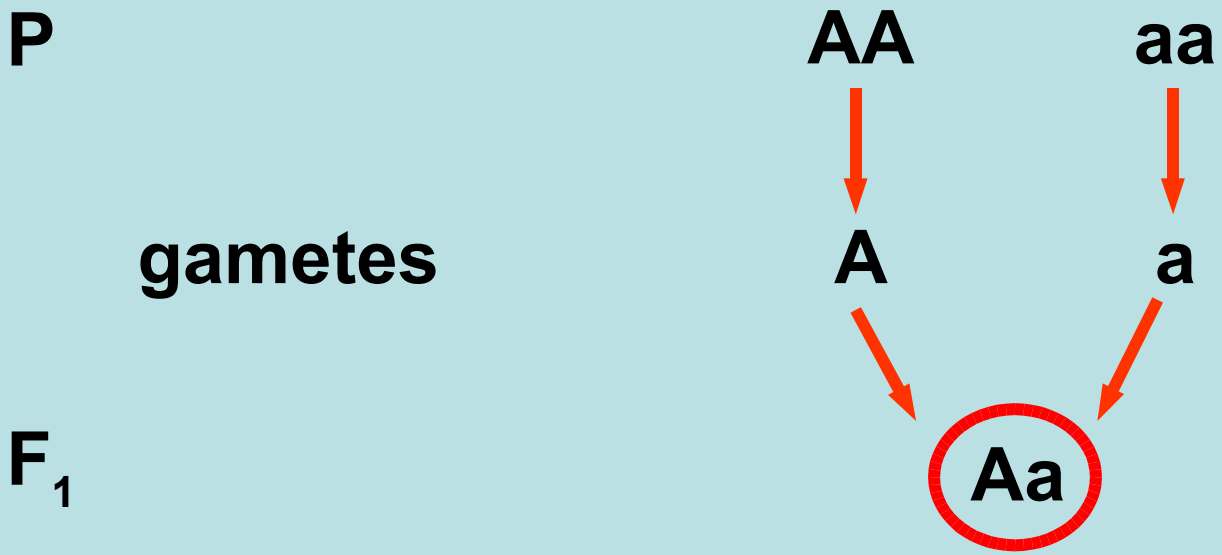
F_2 GENERATION

GENOTYPE 1 : 2 : 1

PHENOTYPE 3 : 1



Monohybridism



gametes

	A	a
A	AA	Aa
a	Aa	a

F2

M o n o h y b r i d i s m

Complete dominance (*KrOt* p. 7/task 1)

	R a t i o s	
t y p e o f b r e e d i n g	**genotypic**	**phenotypic**
heterozygote x rec. homozygote *backcross* **Bc**	**1 : 1**	**1 : 1**
heterozygote x dom. homozygote *(backcross* **Bc***)*	**1 : 1**	**only dominant**
heterozygote x heterozygote *intercross* **F_2**	**1 : 2 : 1**	**3 : 1**

M o n o h y b r i d i s m

(*KrOt* p. 7-8/task 3)

t y p e o f b r e e d i n g			o f f s p r i n g	
			albino	**pigmented**
F_1 (alb x pigm)	**x**	**F_1 (alb x pigm)**	**18**	**61**
Cc		***Cc***	**1**	**3**
F_1 (alb x pigm)	**x**	**albino P**	**32**	**28**
Cc		***cc***	**1**	**1**
F_1 (alb x pigm)	**x**	**pigmented P**	**0**	**61**
Cc		***CC***	**0**	**1**

The albinisms is recessive, the (normal) pigmentation of the coat is **completely dominant**.

M o n o h y b r i d i s m

(*KrOt*, p. 8, task 5)

Polydactyly

Type of hybridization			Offspring		
			Normodactylous	Polydactylous	Total
Lx*/*Lx	**x**	**+/+**	**87** **+/*Lx***	**0**	**87**
+/*Lx*	**x**	***Lx*/*Lx***	**160** **+/*Lx***	**160** ***Lx*/*Lx***	**320**
+/*Lx*	**x**	**+/*Lx***	**1199** **+/+, +/*Lx***	**394** ***Lx*/*Lx***	**1593**

dominant allele +

mutant allele for polydactyly *Lx*

The normodactyly is dominant, and the polydactyly is recessive (*Lx*/*Lx*).

Family	Blood group in children		
	M	MN	N
1	2		
2		1	1
3	1	3	
4		2	1
5	1	1	1
6			2
7		1	1
8	1	1	
9		2	
10	1	1	
11		3	
12		1	2
13	1		
14		1	
15	2		1
16			1
17		1	
18		1	
19		1	1
20		1	

Monohybridism
- phenotypical ratios in humans
(*KrOt*, p. 9, task 6)

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1	2		
2		1	1
3	1	3	
4		2	1
5	1	1	1
6			2
7		1	1
8	1	1	
9		2	
10	1	1	
11		3	
12		1	2
13	1		
14		1	
15	2		1
16			1
17		1	
18		1	
19		1	1
20		1	

Family	Blood group in children		
	M	MN	N
Total	**9**	**21**	**11**

i.e. approx 1 : 2 : 1

CODOMINANCE

Monohybridism
- phenotypical ratios in humans
(*KrOt*, p. 9, task 6)

Family	Blood group in children		
	M	MN	N
1	2		
2		1	1
3	1	3	
4		2	1
5	1	1	1
6			2
7		1	1
8	1	1	
9		2	
10	1	1	
11		3	
12		1	2
13	1		
14		1	
15	2		1
16			1
17		1	
18		1	
19		1	1
20		1	
Total	9	21	11

i.e. approx 1 : 2 : 1

CODOMINANCE

Monohybridism – ABO blood group system

phenotypes and genotypes (*KrOt*, p. 9, task 7)

a)

phenotype	**0**	**A**	**B**	**AB**
genotype	*00*	*AA, A0*	*BB, B0*	*AB*

4

6

b)

rec. homozygote	*00*
dom. homozygote	*AA, BB*
heterozygote	*A0, B0, AB*
codominancy	*AB*

c) Blood group: mother - 0 child - A

(*genotype*) *00* *A0*

man possible as father **A, AB**

(man that can not be excluded as father)

man excluded as father **B, 0**

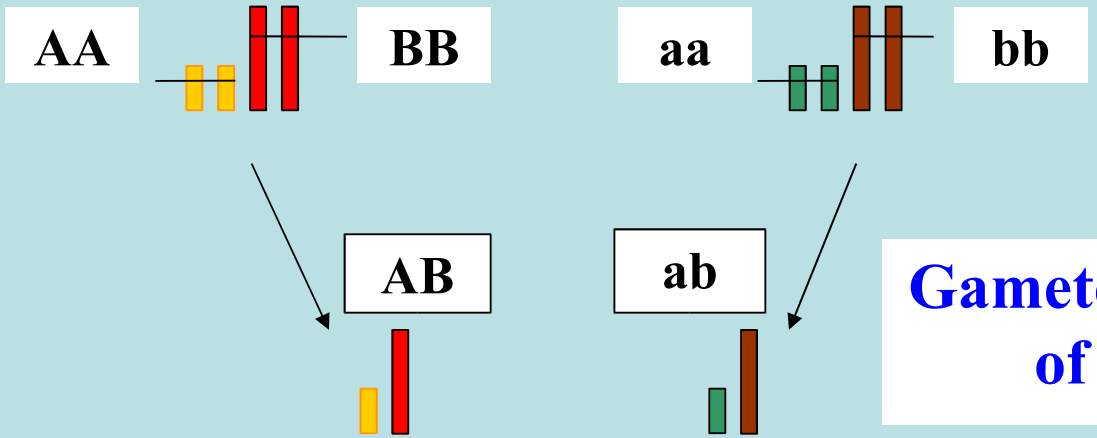
Mother	Child	Man as father	
		impossible	possible
O	A		
O	B		
O	O		
O	AB		
A	A		
A	B		
A	O		
A	AB		
B	A		
B	B		
B	O		
B	AB		
AB	A		
AB	B		
AB	O		
AB	AB		

Monohybridism

– ABO blood group system phenotypes in paternity determination
(*KrOt*, p. 10, task 8)

Mother	Child	Man as father	
		impossible	possible
O	A	O,B	A,AB
O	B	O,A	B,AB
O	O	AB	O,A,B
O	AB	--	mother excluded
A	A		
A	B		
A	O		
A	AB		
B	A		
B	B		
B	O		
B	AB		
AB	A		
AB	B		
AB	O		
AB	AB		

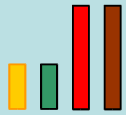
Mother	Child	Man as father	
		impossible	possible
O	A	O,B	A,AB
O	B	O,A	B,AB
O	O	AB	O,A,B
O	AB	--	mother excluded
A	A	--	A,B,AB,O
A	B	A,O	B,AB
A	O	AB	A,B,O
A	AB	O,A	B,AB
B	A	O,B	A,AB
B	B	--	A,B,AB,O
B	O	AB	A,B,O
B	AB	B,O	A,AB
AB	A	--	A,B,AB,O
AB	B	--	A,B,AB,O
AB	O		mother excluded
AB	AB	O	A,B,AB



Parental generation

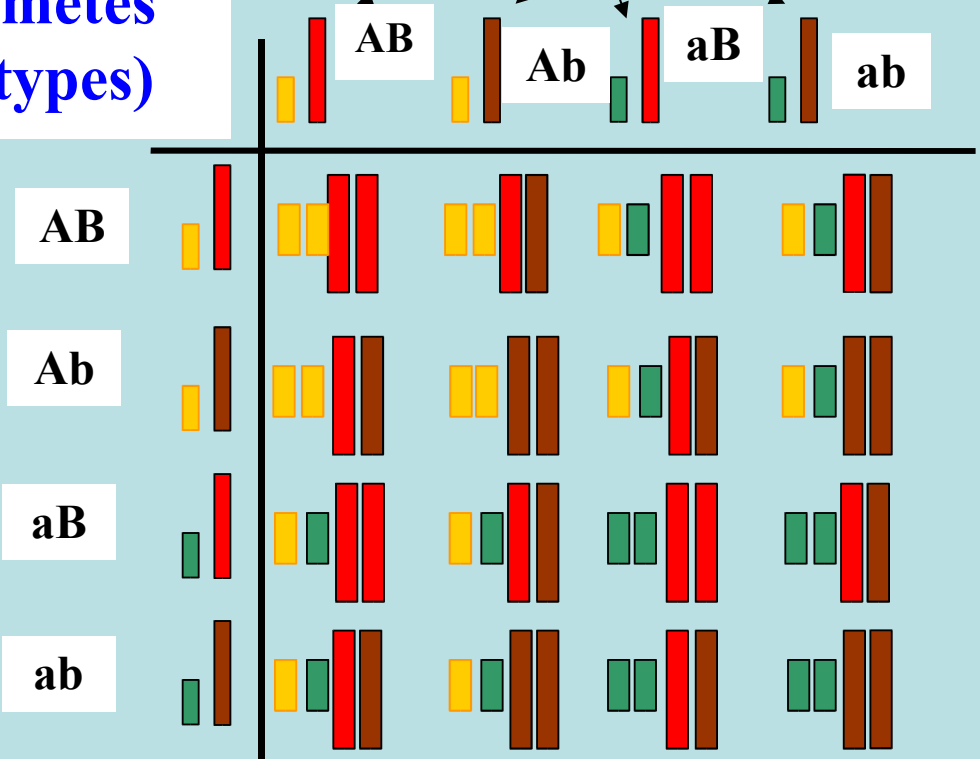
Gametes (haploid number of chromosomes)

DIHYBRIDISM



F_1 generation (heterozygotes AaBb)

Gametes (4 types)



F_2 generation

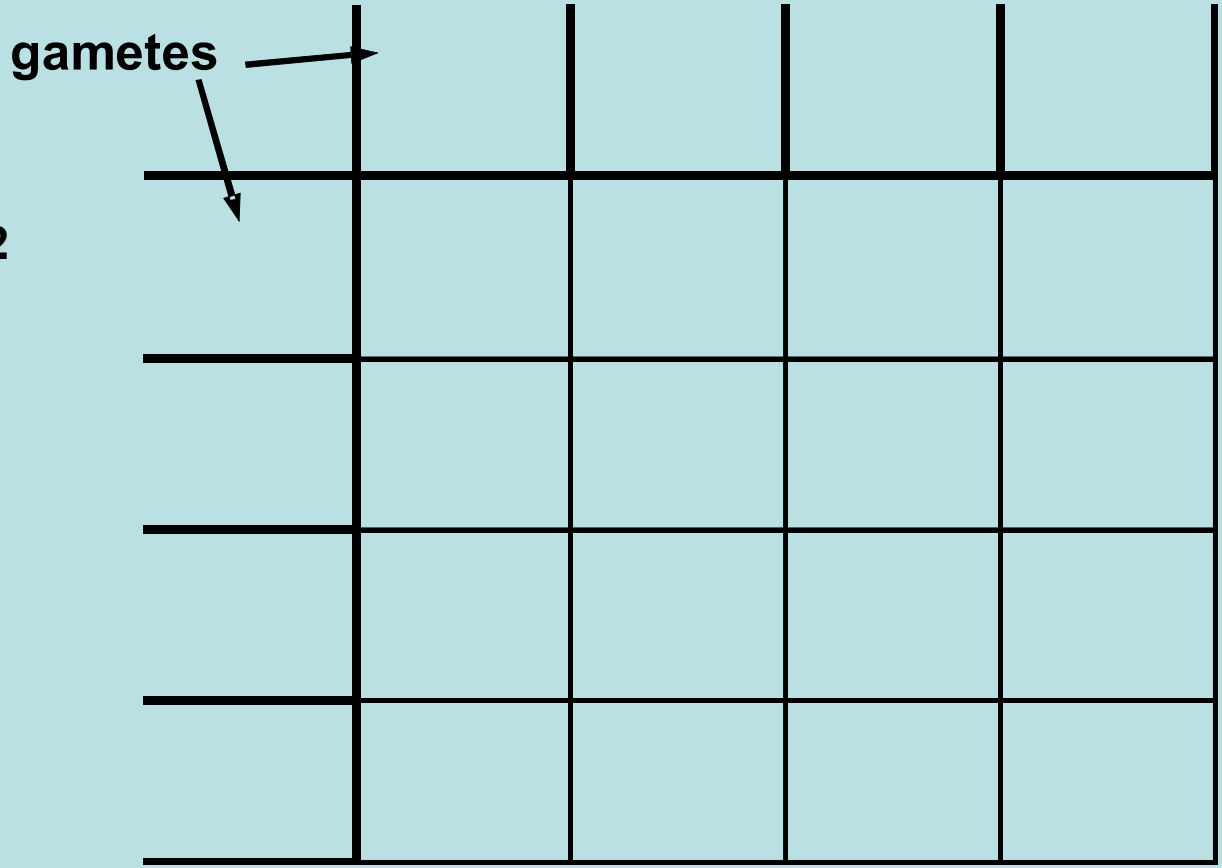
Dihybridism

P

gametes **AB** **ab**

F_1

F_2



Dihybridism

P AABB aabb

gametes AB ab

F_1 AaBb

gametes → / ↓	AB	Ab	aB	ab
AB	AABB	AABb	AaBB	AaBb
Ab	AABb	AAbb	AaBb	Aabb
aB	AaBB	AaBb	aaBB	aaBb
ab	AaBb	Aabb	aaBb	aabb

F_2

Dihybridism – independent segregation of polydactyly and congenital icterus (*KrOt*, p. 12, task 11)

	Offspring			
Types of hybridization genotypes of parents	**Normodactylous nonicteric rats**	**Polydactylous nonicteric rats**	**Normodactylous icteric rats**	**Polydactylous icteric rats**
	98	**26**	**28**	**9**
	36	**34**	**29**	**33**

allele for normodactyly +
mutant allele for polydactyly *Lx*

allele for normal metabolism of bilirubin +
mutant allele for jaundice *j*

Dihybridism – independent segregation of polydactyly and congenital icterus (*KrOt*, p. 12, task 11)

	Offspring			
Types of hybridization **genotypes of parents**	**Normodactylous nonicteric rats**	**Polydactylous nonicteric rats**	**Normodactylous icteric rats**	**Polydactylous icteric rats**
+/Lx +/j **x** ***+/Lx +/j***	**98**	**26**	**28**	**9**
+/Lx +/j **x** ***Lx/Lx j/j*** ***+/Lx j/j*** **x** ***Lx/Lx +/j***	**36**	**34**	**29**	**33**

allele for normodactyly +
mutant allele for polydactyly *Lx*

allele for normal metabolism of bilirubin +
mutant allele for jaundice *j*

Dihybridism

– paternity examination by combination of two blood group systems (*KrOt*, pp. 13-14, task 14)

Blood groups			
Mother	Child	Man possible as father	Man impossible as father
0, M	0, MN		
0, Rh+	0, Rh-		
0, Rh-	A, Rh+		
0, MN	B, MN		
A, N	0, MN		
A, MN	A, N		
A, Rh+	B, Rh-		
A, Rh-	A, Rh+		
A, N	AB, MN		
B, MN	0, N		
B, Rh+	B, Rh-		
B, Rh-	B, Rh-		
B, M	0, M		
AB, N	A, N		
AB, Rh+	B, Rh-		
AB, Rh-	AB, Rh+		
AB, MN	AB, M		

Dihybridism

– paternity examination by combination of two blood group systems (*KrOt*, pp. 13-14, task 14)

Blood groups			
Mother	**Child**	**Man possible as father**	**Man impossible as father**
0, M	0, MN	A, B, 0, N, MN	AB, M
0, Rh+	0, Rh-	A, B, 0, Rh+, Rh-	AB
0, Rh-	A, Rh+	A, AB, Rh+	B, 0, Rh-
0, MN	B, MN	B, AB, M, N, MN	A, 0
A, N	0, MN	A, B, 0, M, MN	AB, N
A, MN	A, N	A, B, 0, AB, N, MN	M
A, Rh+	B, Rh-	B, AB, Rh+, Rh-	A, 0
A, Rh-	A, Rh+	A, B, 0, AB, Rh+	Rh-
A, N	AB, MN	B, AB. M, MN	A, 0, N
B, MN	0, N	A, B, 0, N, MN	AB, M
B, Rh+	B, Rh-	A, B, AB, 0, Rh+, Rh-	
B, Rh-	B, Rh-	A, AB, B, 0, Rh+, Rh-	
B, M	0, M	A, B, 0, M, MN	AB, N
AB, N	A, N	A, B, 0, AB, N, MN	M
AB, Rh+	B, Rh-	A, B, 0, AB, Rh+, Rh-	
AB, Rh-	AB, Rh+	A, B, AB, Rh+	0, Rh-
AB, MN	AB, M	A, B, AB, M, MN	0, N