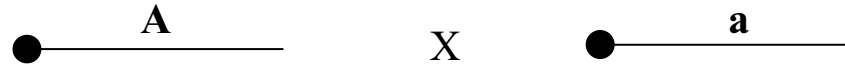# TETRAD ANALYSIS IN FUNGI

Image removed to due to copyright considerations.
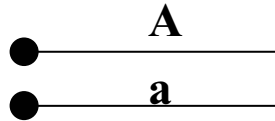
THE PRODUCTS OF A SINGLE MEIOSIS
ARE PACKAGED IN A SAC (ASCUS)

THE PRODUCTS OF A SINGLE MEIOSIS

Haploid   A   X   a

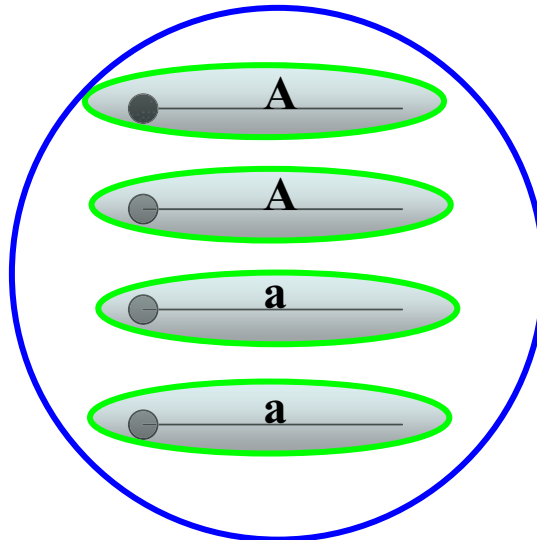**Diploid**   A
              a
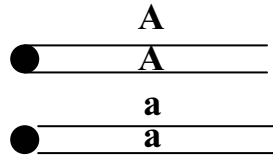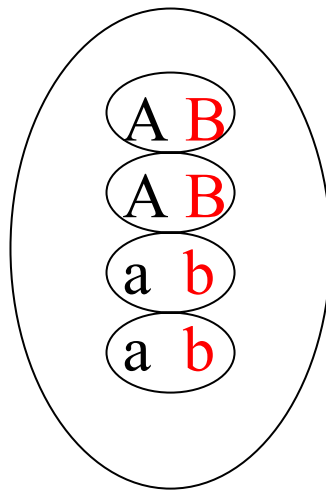
1st
division
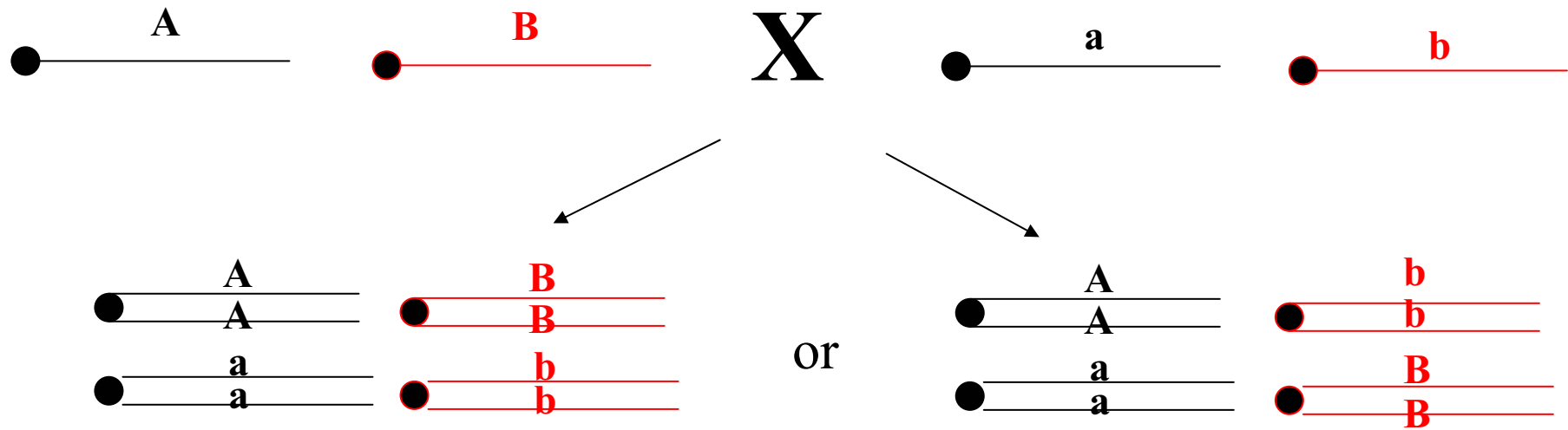Meiosis

A
A
a
a

A

A

a

a

Image removed to due to copyright considerations.

Mendel

1. Segregation: Equal numbers of A and a
   - The phenotype resulting from a mutation in a single gene will segregate exactly 2A : 2a.

   - Question in Tetradspeak:
   Does the phenotype segregate2:2?
   Yes. A and a are alleles of a single gene.

HOW DO WE KNOW WHETHER TWO GENES ARE LINKED?

A   B   **X**   a   b

A   B   A   b
A   B   A   b
a   b   a   B
a   b   a   B

                    or

(A B)   (A b)
(A B)   Parental   (A b)   Non-Parental
(a b)   Ditype   (a B)   Ditype
(a b)   (PD)   (a B)   (NPD)

How do you determine linkage?

You cross AB x ab and find in 100 tetrads:

48 PD
52 NPD

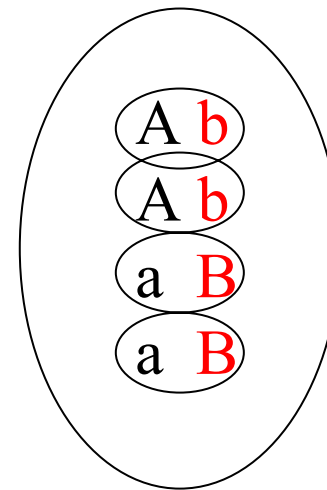**Are A and B linked?**

Mendel

1. Segregation: Equal numbers of A and a
   - The phenotype resulting from a mutation in a single gene will segregate exactly 2A : 2a.
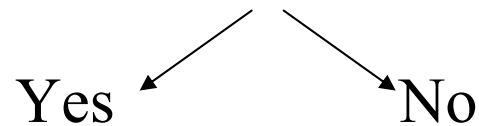
   - Question in Tetradspeak:
   Does the phenotype segregate 2:2?
   Yes. A and a are alleles of a single gene.

2. Independent Assortment (linkage): AB x ab
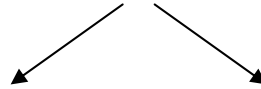   - Tetradspeak: Are PD = NPD

   Yes   No

   Two genes are unlinked   *Two genes are linked*
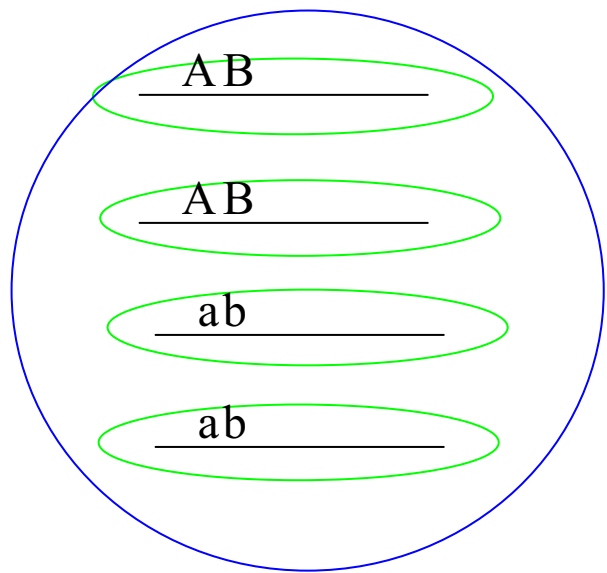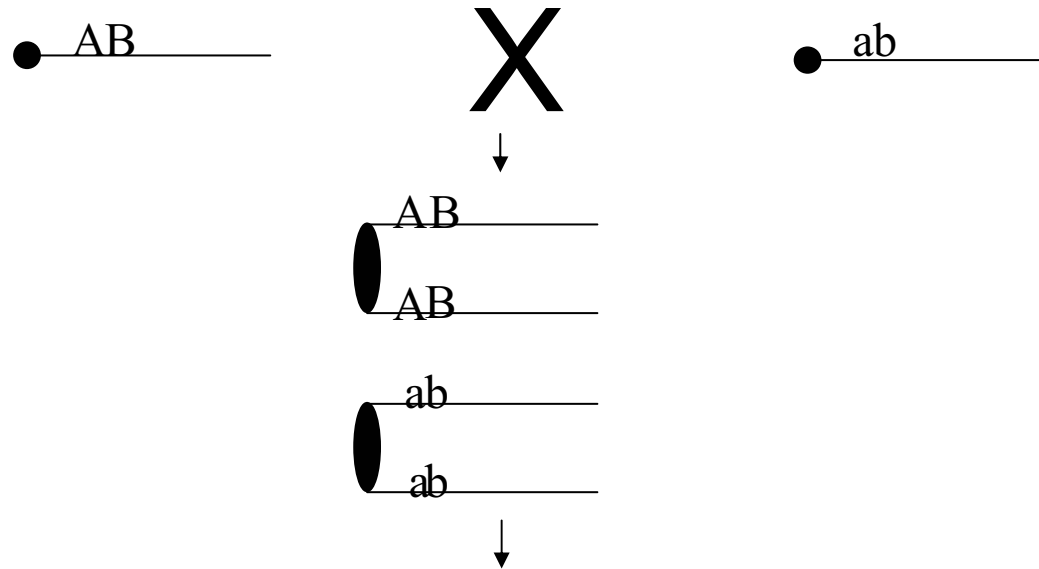
Independent Assortment (linkage): AB x ab
•Tetradspeak: Are PD = NPD

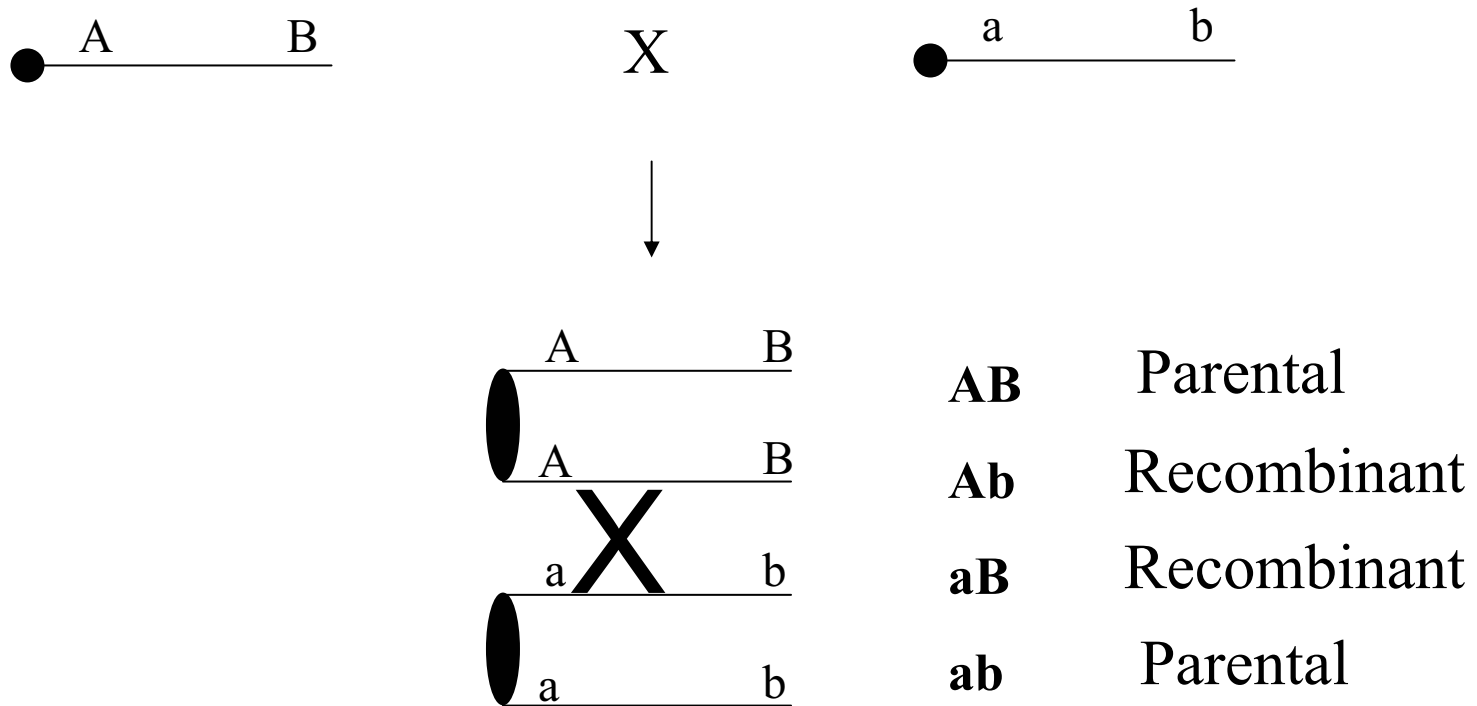*Two genes are unlinked*   *Two genes are linked*

Complete Linkage of Two Genes

AB

X

ab

↓

AB

AB

ab

ab

↓

A B

A B

ab

ab

Parental ditype

AB

AB

ab

ab

The Products of a Single Crossover

A ─────── B   X   a ─────── b

A ─────── B   **AB**   Parental

A ─────── B   **Ab**   Recombinant

a ──╳── b   **aB**   Recombinant

a ─────── b   **ab**   Parental

TETRATYPE

2. Independent Assortment (linkage): AB x ab
    •Tetradspeak: Are PD = NPD

Yes   No

Two genes are unlinked   ***Two genes are linked***
                                  TETRATYPE?

                                  Yes   NO
                                                         100% linked

$$\text{Map Distance centiMorgans} = \frac{1/2 \text{ TT}}{\text{TOTAL}}$$
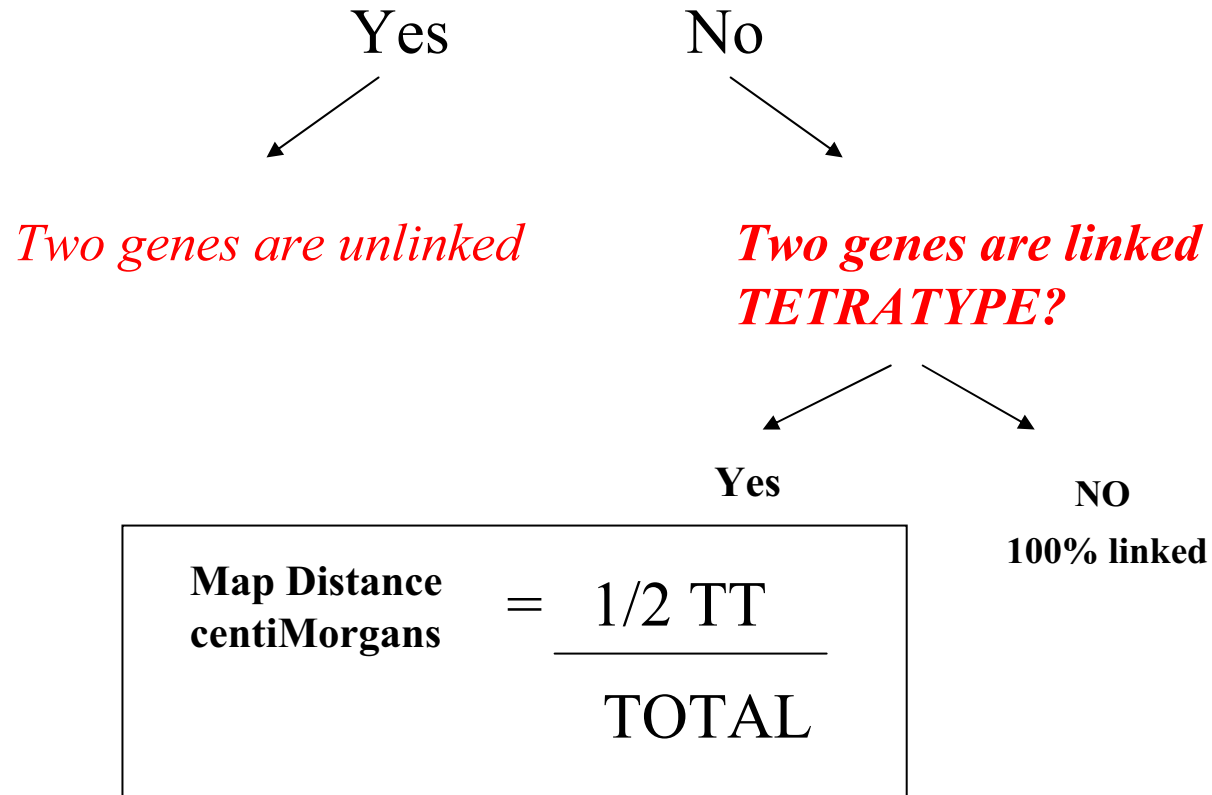
How do you determine linkage?

You cross AB x ab and find in 100 tetrads:

90 PD
10 TT

Are they linked?

90 PD = 90 X4 = 360 Non-Recombinant Progeny
10 TT = 10 x 2 = 20 Recombinant Progeny

MD in centimorgans = $\dfrac{\text{Recombinants}}{\text{Total tetrads}}$ X 100

MD = 20/400= 5 centiMorgans

Map Distance centiMorgans = $\dfrac{\text{1/2 TT}}{\text{TOTAL}}$

Linkage AB x ab
   Are PD = NPD?

Yes   No

Two genes are unlinked   **Two genes are linked**
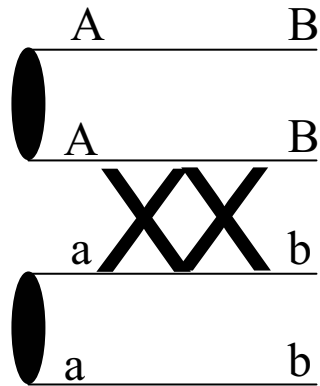   **TETRATYPE?**

                       Yes   **NO**

                                          100% linked

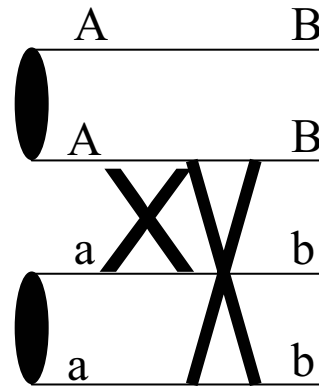**Map Distance**   = $\dfrac{1/2\ TT}{TOTAL}$
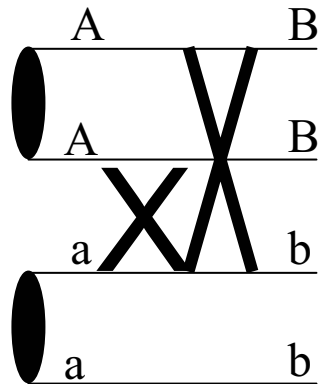
WHAT ABOUT DOUBLE CROSSOVERS?
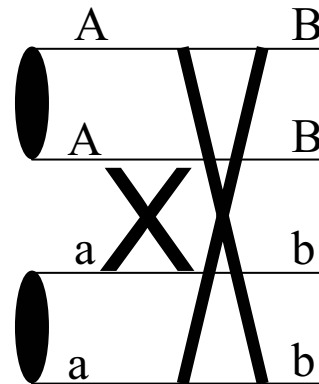
DOUBLE CROSSOVERS

PD

AB
AB
ab
ab

TT

AB
Ab
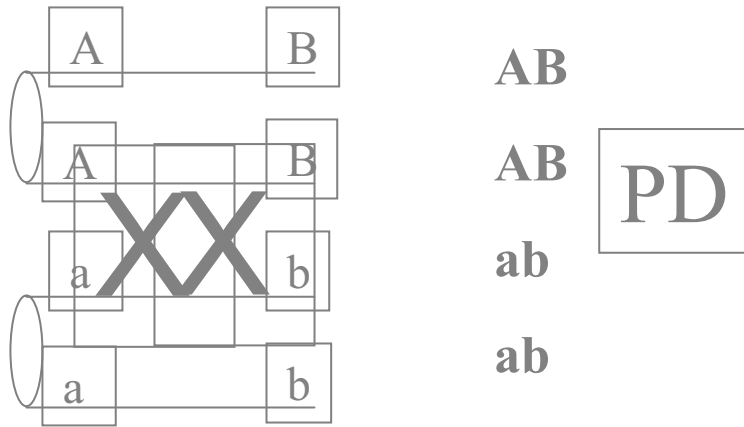ab
aB

TT

Ab
AB
aB
ab

NPD

Ab
Ab
aB
aB

1PD : 1NPD :2TT

CROSSING OVER OCCURS AT THE 4 STRAND STAGE

AB

AB   PD

ab

ab

AB

Ab   TT

ab

aB

Ab

AB   TT

aB

ab

Ab

Ab   NPD
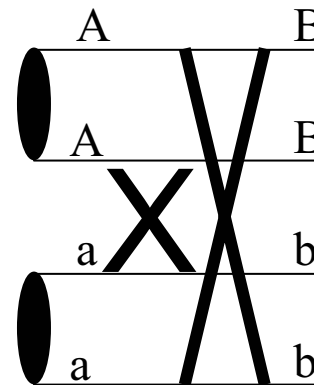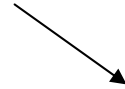
aB

aB
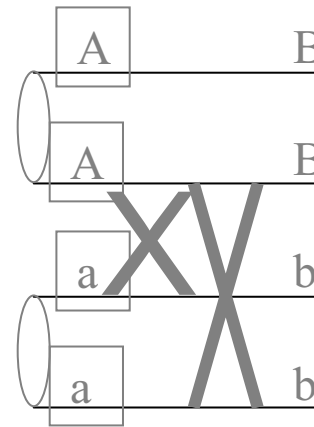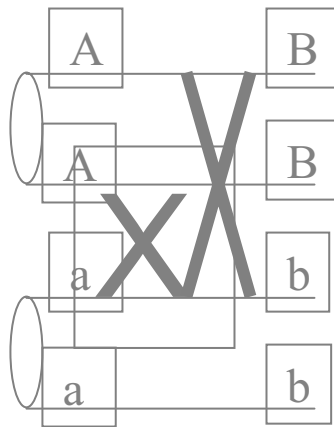
Linkage AB x ab
   Are PD = NPD?

Yes   No

Two genes are linked
TETRATYPE?

Two genes are unlinked

Yes   **NO**

                    100% linked

Map Distance $=$ $\dfrac{1/2\ \text{TT}}{\text{TOTAL}}$

NPD?
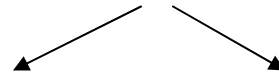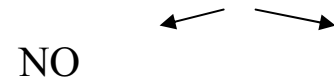
NO   YES

SINGLE   DOUBLE

MD = $\dfrac{1/2\ \text{TT}\ +\ 3\text{NPD}}{\text{TOTAL}}$

ESTIMATION OF DOUBLE CROSSOVERS

Singles = TT

Doubles = 1PD :2TT: 1NPD

Single   1/2 (TT-2NPD)

Doubles   4NPD

$$MD = \frac{1/2(TT-2NPD) + 4NPD}{Total}$$

SINGLE   DOUBLE

$$MD = \frac{1/2\ TT\ +\ 3NPD}{TOTAL}$$

How do you determine linkage?

You cross AB x ab and find in 100 tetrads:

70 PD
20TT
10NPD

Count crossover gametes $= \dfrac{40 + 4\,(10)}{400}$ **X 100 = 20 cM**

Analyze tetrads $= \dfrac{10 + 30}{100}$ **X 100 = 40 cM**

If we just count crossover gametes we would underestimate the distance.

THE THREE TYPES OF TETRADS

Parental	Non-Parental	Tetratype
A B	A b	A B
A B	A b	A b
a b	a B	a B
a b	a B	a b

NO ONE TETRAD TYPE IS SUFFICIENT.

IT IS THE RELATIONSHIP THAT TELLS ALL