MENDEL'S MONOHYBRID CROSS

Date 4.11.20

→ performed experiments on different characteristics.
e.g. height

1 'pure' tall pea plant
1 'pure' short pea plant
> cross fertilize

→ if you self pollinate a pure tall plant → it would give you all tall plants
(self pollinate ↓ pollen from same plant in female rep. part)

→ if you self pollinate a pure short plant → it would give you all short plants

if you achieve these results, then it is a pure short/tall plant.

- Mendel prepared these pure breeds
- He cross pollinated them [moving pollen grains from tall → fem. of tall
  " " " short → female of tall
- sowed the seeds

⇒ He got all tall plants — 100% tall → called (F1)
F1 = filial = son/daughter

- took F1 generation plant → self pollinate
  ↓
  grows seeds
  ↓
  sow seeds

Date

F1 (self pollinate) → seed - tall and short plants → (F2)

in the ratio 3 : 1

tall : short.

– He got same ratio for all characteristics Ex e.g colors purple & white.

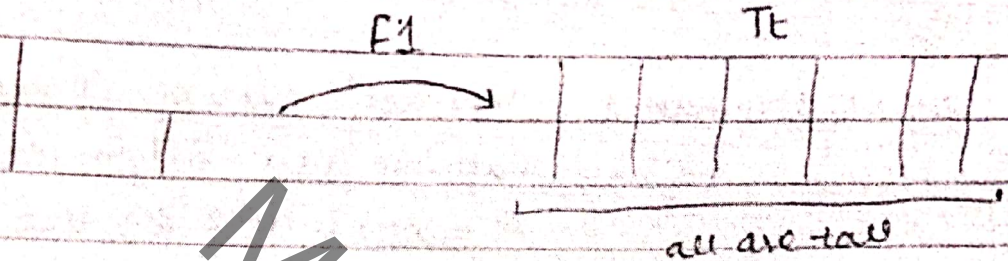
* He also cross-pollinated the F1 and still got the same ratio.

DOMINANCE AND SEGREGATION LAWS

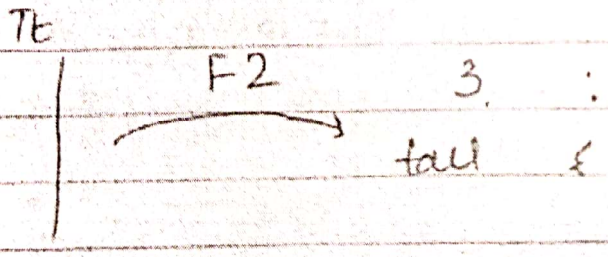
Date 4.11.20

LAW OF DOMINANCE

When you crossed the tall & short plant, both traits (tall & short) got passed along.

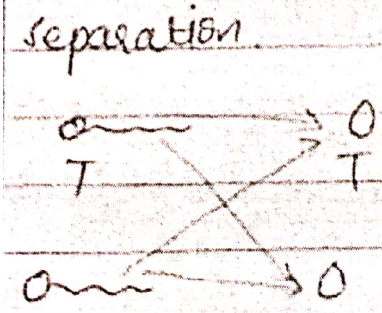


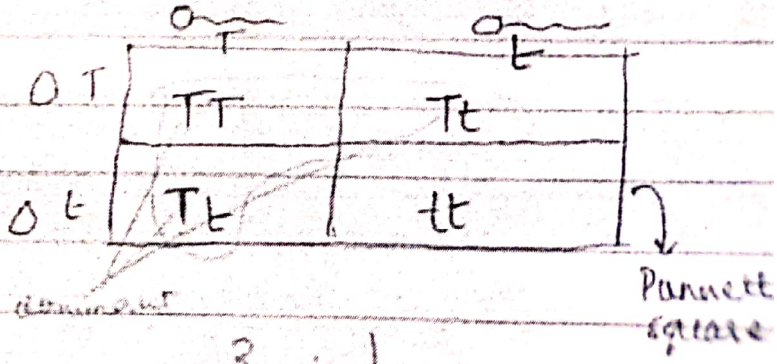
- So, tall trait (T) is dominant → EXPRESSED
  ↓
  what you see
- Short trait (t) is recessive → HIDDEN in presence of dominant



LAW OF SEGREGATION

separation





3 : 1

DEFINITIONS

i. pure bred : pure bred short plants always produced short offspring.
pure bred tall plants always produced tall offspring.

ii. law of dominance : Mendel's law of dominance states that one trait will conceal the presence of another trait for the same characteristic

iii law of segregation : The law states that each individual that is diploid has a pair of alleles (copy) for a particular trait. Each parent passes an allele at random to their offspring resulting in a diploid organism.
- The allele that contains the dominant trait determines the phenotype of the offspring.

Date 4.11.20

→ Heredity : How traits are passed down from parents to offspring.

- traits are coded in the DNA.
- some of them can be influenced by environment for e.g. malnourishment.

E.G. of traits : height / eye colour / hair colour / risk of certain diseases.

☆ Entire DNA code is in most of the body cells. (DNA in nuclei)

• DNA : deoxyribonucleic acid
- a type of nucleic acid
  ↳ a type of biomolecule.
  ↳ made up of building blocks called nucleotides
    - sugar ⬠
    - phosphate ⬭
    - nitrogenous base ▭

☆ sequence of bases can code for traits
- Adenine
- Thymine
- Guanine
- Cytosine

Apples in the Tree
(Adenine & Thymine go together)
Car in the Garage
(Cytosine & Guanine

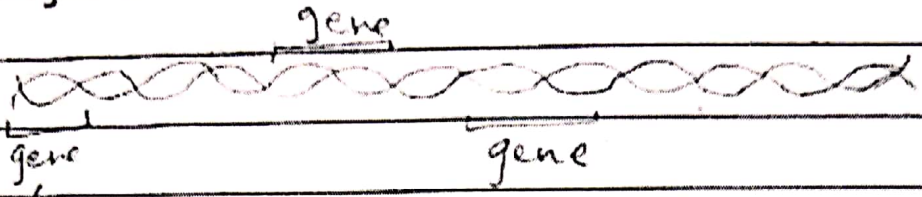
Date

bases are held together by hydrogen bonds.
DNA is twisted in 'double helix' shape.

Genes

portions of DNA make up genes.

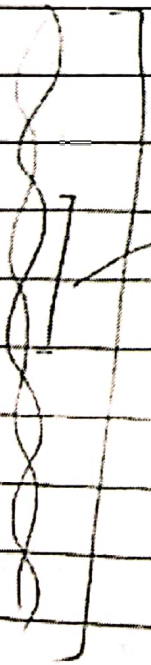
for e.g



↳ can code for:

proteins → huge role in expressing a trait.

* Not all genes are used to make protein. Parts of DNA can be non-coding

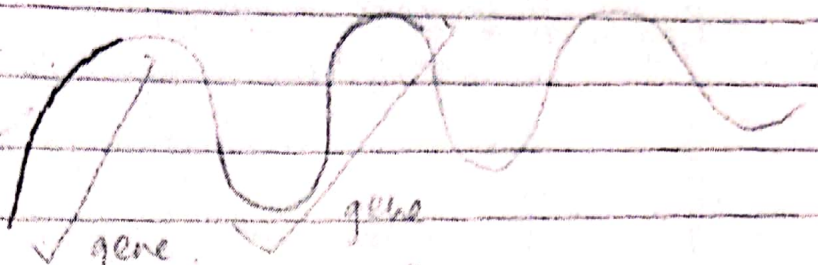


↳ different regions of this could code for multiple proteins

for e.g. → could code for a specific protein.
We would call this a gene

Date

A	T
T	A
G	C
A	T
A	T



gene

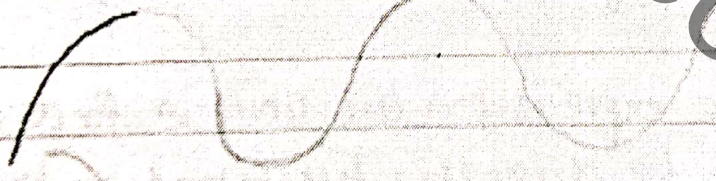
code for a specific protein

codes for a specific protein

so you have two sections of DNA that code for specific things like e.g. pigmentation, skin etc.

Not always coding for protein

If you code for a protein



DNA

Transcription (Gene → RNA)

mRNA

tRNA (transport amino acids)

Translation (RNA → protein)

protein

Codon

every 3 of base pairs

each of their codes for an amino acid → together form

mRNA is read 3 bases at a time

protein

Date

- t RNA helping to transport the appropriate amino acids to the mRNA in the ribosomes.
- Gene
  ↓ transcription
  RNA
  ↓ translation
  protein

★ RNA can have an in between messenger function but can also play a structural or functional role as well.

Gene: A gene is a sequence of nucleotides in DNA or RNA that encodes the synthesis of a gene product, either RNA or protein.
→ During gene expression the DNA is first copied into RNA. RNA can be directly functional or be the intermediate template for a protein that performs a function.

information encoded in a gene is used to direct the assembling of a protein molecule
(diagram on previous pg.)
- to express a gene written basically

contains huge stretches without any protein coding genes.

(from book) Date 9.11.20

A gene is a UNIT of a CHROMOSOME
It is a small segment of DNA in a chromosome that controls a particular characteristic

a gene is placed on a particular position → LOCUS

* the place where it is located is called GENE LOCUS.

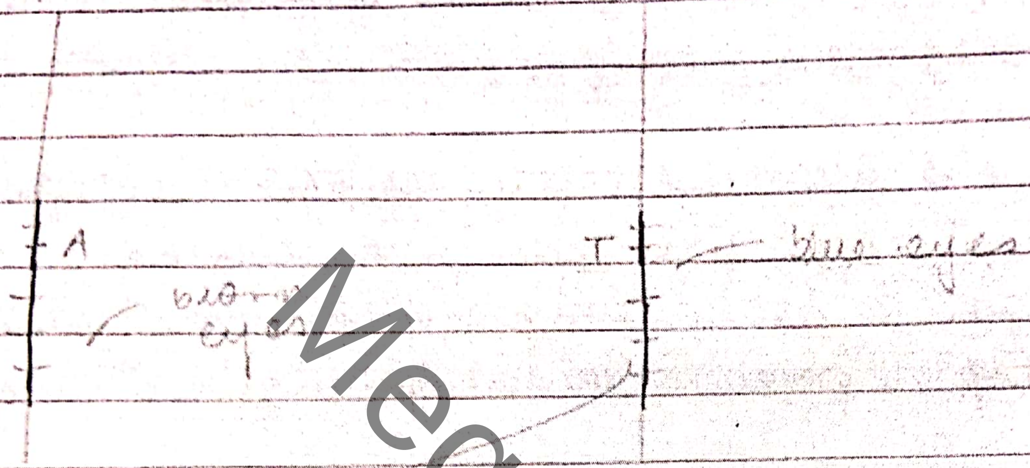
A gene is a special stretch of DNA, a sequence of A_s, C_s, T_s, G_s, that codes for something.
each gene is like a "unique recipe" which makes a protein or group of proteins (usually)

Date

Alleles

- Allele is a specific variation of a gene

for e.g → look at same section of DNA for 2 people



- look at the gene on both DNA. (same gene)
- both are human beings & they've similar genetic material
- but they might have variations in how the DNA is coded
- 1 might have an adenine & the other a thymine

- 2 different alleles on the same gene

→ It is encoding for the same protein, but there's a variation in how its coded

for e.g. → coding for eye colour but variation might lead to brown, blue etc eyes

- Both genes are eye-colour genes but can have different versions → alleles.

logous chromosomes: similar not identical. One from mother, one from father. Carries the same genes but alleles for each trait may not be same.

Date

Alleles occupy the same relative positions on a pair of homologous chromosomes.
Are represented by letters.

Allele is an alternative version of a specific gene.

an individual inherits 2 alleles for each gene, one from each parent

If the 2 alleles are same - the individual is homozygous for that gene

If the alleles are different - the individual is heterozygous

- capital letter : dominant small - recessive

Date 12.11.20

⟹ **Genotype**: A genotype is an organism's SET of heritable GENES that can be passed down from parents to offspring.

— a genotype is the GENETIC MAKEUP (pairs of alleles), combination of genes in an org.

- **Homozygous**: An org is homozygous for a trait if the 2 alleles controlling the trait are identical.

for e.g. TT or tt
↓ ↓
homozygous dominant — homozygous recessive

- **Heterozygous**: An org is heterozygous for a trait if the alleles controlling the trait are different

for e.g. Tt

⟹ **Phenotype**: The EXPRESSED trait in an org. (outward appearance)

Phenotype : result of genes + effect of environment.

— dom allele — expressed
— same phenotype for homo & hetero

— rec. allele — hidden in dom.
— expresses in homo NOT hetero

TEST CROSS Date 14.11.20

Q1.

Normal skin pigmentation is caused by gene A.
Albinism is caused by double recessive (aa).
What are the chances of getting an albino from the following crosses?

Aa x ad

Aa x Aa

aa x aa

AA x aa

1

	A	a
a	Aa	aa
a	Aa	aa

50% chance of albinism

2

	A	a
A	AA	Aa
a	Aa	aa

25% chance

3

	a	a
a	aa	aa
a	aa	aa

100% chance

4

	A	A
a	Aa	Aa
a	Aa	Aa

0% chance

Date

Q2

- A man had three animals of the same species, all three were black, two female and one male. He allowed them to breed and each female had eight offspring. In one case all were black, in others, two brown and six black offspring.
- Use B for dominant and b for recessive alleles.
- Explain this information using genetic diagram giving genotypes and phenotypes of all three parents.

Date 14.11.20

Punnett square

figure out genotype (heterozygous, homozygous dominant, homozygous recessive)

Place one parent on top of the Punnett square & the other on the left.

e.g. crossing 2 heterozygous guinea pigs. (hair or no hair)

	H	h
H	HH	Hh
h	Hh	hh

Q. genotypes?

- you can list them out

1 HH, 2 Hh, 1 hh

genotype ratio: 1HH : 2Hh : 1hh → 1 : 2 : 1

or percentage.

- 25% HH
- 25% hh
- 50% Hh

* homo D. to 2 Hetero to 1 homo R.

Q. Phenotypes

- whether they have hair or not? (capital → has hair)

HH, Hh → 3 have hair

hh → 1 doesn't (no dom. allele)

Date

- 3 have hair and 1 doesn't

→ Ratio: 3 : 1

→ Percentage: 75% hairy
25% hairless

☆ Punnet Squares are predictions. These are probabiliti

Incomplete Dominance

Date 14.11.20

Incomplete dominance is when a dominant allele, or form of a gene, does not completely mask the effects of a recessive allele and the organism's resulting physical appearance shows a blending of both alleles. Also called semi-dominance or partial dominance.

you see an 'in-between' phenotype; that is different from BOTH the dominant & recessive alleles, & appears to be a mixture of both.

for e.g. pink offspring for red and white flowers

R ✕ R

	R	R
r	Rr	Rr
r	Rr	Rr

examples in humans
skin colors
one parent with straight hair and one with curly can have a child with wavy hair.
Eye colors
Height

→ Both alleles in the genotype are expressed equally
* I^A & I^B exhibiting codominance (AB)

Codominance

Date 15.11.20

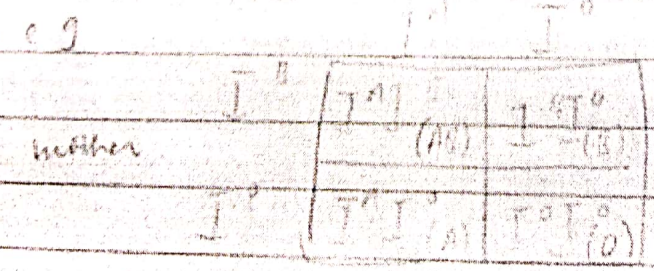
Q) explain codominance by reference to the inheritance of the ABO blood group (phenotypes A, B, AB, O, gene alleles I^A, I^B and I^O

- 4 blood groups: A, B, AB & O.

genotype	phenotype
I^AI^A or I^AI^O	A
I^BI^B or I^BI^O	B
I^AI^B	AB
I^OI^O	O

- 3 alleles for blood group → "MULTIPLE ALLELES"
  I^A, I^B & I^O
- we only have 2 of them (one from each parent)
- I^A & I^B are codominant
- I^O is recessive to both I^A & I^B

e.g



* Blood type is an example of both multiple alleles and codominance.

1) describe the determination of sex in humans (XX & XY chromosomes)

SEX DETERMINATION.

Date 23.11.20

- 2 of 46 chromosomes are "sex chromosomes"
- called the X and the Y chromosomes (has nothing to do with their shape.
- all other chromosomes are called "autosomal chromosomes"

- females have 2 X chromosomes
- Males have 1 X and 1 Y chromosome.

☆ karyotype: A karyotype is an individual's collection of chromosomes.

- 22 of the chromosome pairs contain the genes which determine inherited characteristics only
- However, one of the pairs contains the genes that determine sex

father / mother	X	Y
X	XX	XY
X	XX	XY

50% female 50% male ratio 1:1

→ these are just probabilities

Date 1.12.20

Codominance & Multiple alleles. (DEFINITIONS)

⇒ Codominance : Codominance results when the two alleles controlling a trait are both expressed in the organism.

e.g. I^A & I^B → AB blood type
(both dominant.)

⇒ Multiple alleles : A term used for a gene that exists in more than 2 alleles.

e.g. blood groups (I^A, I^B & I^o)

Co-dominance : both alleles expressed.

Incomplete dominance : neither fully expressed. 'Blending' of both.

Date 3.12.20.

describe the difference between continuous and discontinuous variation and give examples of each.

Discontinuous Variation : Traits that show clear-cut phenotype with no intermediate forms between these traits.

- clearly defined differences in a characteristic that can be observed in a population.
- controlled by one or a few genes
- easily distinguishable.

e.g. - ABO blood group
- double or single eyelid
- ability to roll tongue

Continuous Variation : characteristic that changes gradually over a range of values. ∴ has a range of phenotypes.

- controlled by many genes
- affected by environment.

e.g. - skin colour
- height
- weight

MUTATIONS.

Date 3.12.20

Mutation : change in the structure of a gene or in the chromosome number.

- Mutations can be neutral, harmful or helpful.
- They are RANDOM.

g) describe mutation as a change in the structure of a gene (e.g. sickle cell anaemia) or in the chromosome number (e.g. 47 in Down's syndrome instead of 46.)

h) name radiation & chemicals as factors that may increase the rate of mutation.

☆ Mutations are random but there can be factors that make them more likely to occur
- excessive radiations
- certain types of chemicals.

- Mutations can be dominant or recessive.
  ↓
  easier to detect.

Date

Gene Mutations

change in one or more DNA bases can make different protein to be produced which can affect an organism's traits.

Mutations can include:

Substitution : wrong base is matched
Insertion : extra base(s) are added } frameshift mutation (everything read after will would be affected)
deletion : base is removed

3 bases are read in 3's

insertion

deletion

error in replication (substitution / insertion/deletion)
harmful, helpful or neutral — mutations.

altered gene → different protein

LUCK

SICKLE-CELL ANAEMIA.

Date 6.12.20

- an example of gene mutation :

- affects RBCs - which transport oxygen from the lungs to all the tissues in the body

- To perform this RBCs have Hb.

☆ In this disease a genetic mutation alters the haemoglobin. (normal → Hb A)

- the mutated gene produces Hbs

- Hb proteins float independently in normal conditions

- In sickle-cell disease, their structure is altered and these mutated proteins (Hbs molecules) clump together → making the cell 'sickle-shaped' and making bands like structures giving a sickle shape

These :- clump together
- cause a sickle shape
- unable to squeeze through blood capillaries

☆ Cells can pile up or even block the vessel completely
↳ this keeps O_2 from reaching many tissues.

mutated Hb (Hbs) → less affinity for O_2

Date

normal ← Hb^A Hb^A

carrier ← hetero ← Hb^A Hb^S

disease ← Hb^S Hb^S

WITH MALARIA. ~~poo~~ sickle-cell anemia provides protection against malaria which is why more likely to pass it one (% age they're unaffe by malaria survive)

→ malaria uses RBCs as incubators.

→ structural changes make them more resistant.

* if only one copy of disease is inherited (heterozygous), just enough mutated Hb to make things difficult for malaria while maintaing normal shape & function

helps in Africa. - helps with evolutionary advantage.

BUT! from 2 parents → sickle-cell disease.

	Hb^A	Hb^S
Hb^A	$Hb^A Hb^A$	$Hb^A Hb^S$
Hb^S	$Hb^A Hb^S$	$Hb^S Hb^S$

1 : 2 : 1 → genotype

normal : carrier : diseased → phenotyp

Chromosome Mutation

human chromosome no : 46

23 (sperm cell) + 23 (egg cell)

mutation can happen during : DNA replication
: Meiosis

mutation may cause change in chromosome no.

case being studied → extra copy of chromosome.

DOWN'S SYNDROME

Date

~~in sex cells (not autosomal/somatic)~~
~~is present or.~~
mutation in sex cell/gamete & fertilization occurs then all of the baby's cells carry the mutation

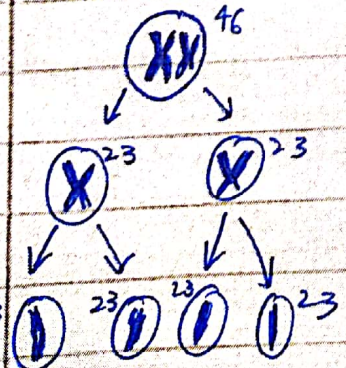
- 47 chromosomes (extra copy of chromosome 21)
- caused by 'non-disjunction' (21st chromosome.)
  ↓
  failure of paired chromosomes to separate and the gametes produced possesses 24 chromosomes

→ CHARACTERISTICS.

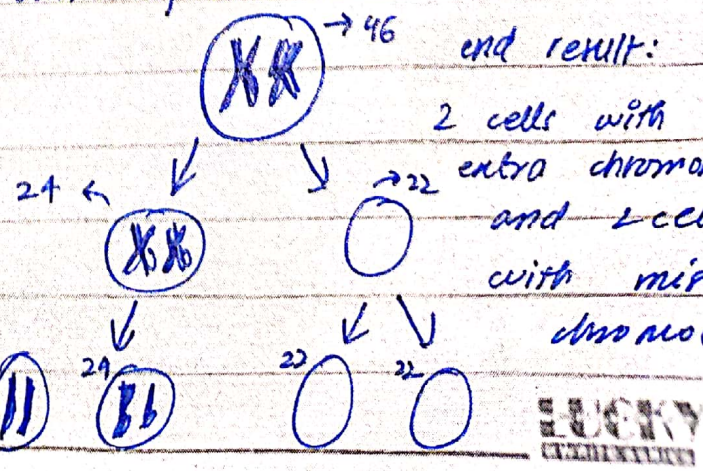
- flattened, broadened face
- narrow eyes
- learning difficulties
- shorter life expectancy
- lower IQ (moderate - mild)
- higher risk of some conditions

⊛ As the mother gets older probability increases. (esp. over 40.) (Issue ovum mein hota hai/ya sperm mein bhi)

Normal Meiosis



Down's Syndrome wala Meiosis



end result:
2 cells with extra chromosom
and 2 cells with missi
chromoson

OR in 2nd step

MUTAGENIC AGENTS:

Date

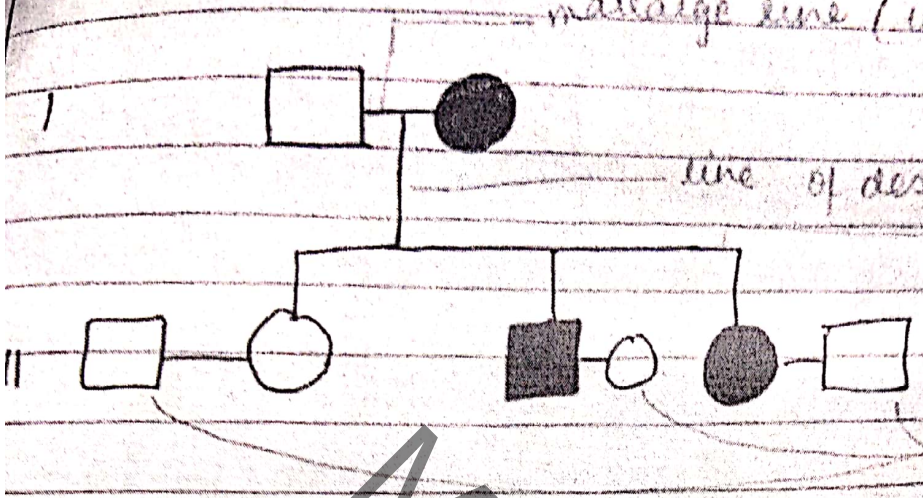
rate of mutation can be increased with presence of certain agents in the EXTERNAL environment.
↳ called 'mutagens'

Radiations: - ultraviolet light
- alpha, beta, gamma radiations.

certain chemicals: - tar & formaldehyde in cigarette smoke.
- drug called LSD (lysergic acid diethylamide)

PEDIGREES.

Date



□ : male (square)

○ : female (circle)

if coloured in. → that person exhibits the trait - phenotype (OBSERVED)

roman numbers : generation

shaded/coloured : show trait being tracked in the pedigree.