

TOPIC : Principles of Inheritance & Variation

Pre-content/Content/ Post-Content	Learning Outcome/Objectives	
	General	Specific
Pre-Content Basic Knowledge of genetics-heredity & variation; Experiments done by Mendel-taking one character into account – Monohybrid cross, sex-determination in humans Content Laws of Inheritance, non - Mendelian ratios, chromosomal theory of inheritance, linkage & crossing over, mutation. Sex- determination in animals. Genetic disorders. Post-Content Analysis of (unknown) pedigree chart. To discuss case studies of persons suffering from Down's syndrome and other genetic disorders.	Students will be able to: Comprehend why they resemble & at the same time do not resemble their parents Predict genetic disorders by studying & analyzing pedigree charts Generate awareness about PWD Act Empathize with children suffering from genetic disorders	Students will be able to : - Work out monohybrid & dihybrid crosses - State the laws of inheritance - Differentiate between Mendelian and non-Mendelian inheritance - State 'Chromosomal Theory of Inheritance' - Explain linkage & crossing over - Decipher the genetic trait/ disorder from a given pedigree chart. - Reason out why genetic disorders are caused and state their symptoms.

Homework and Assignments:

To answer questions at the end of the chapter

To solve problem questions related to inheritance & find the ratios involved

To study pedigree charts and interpret if the trait is dominant/recessive and autosomal/sex-linked

Teacher's Activity	Student's Activity	Teacher's Observation And Remedial
Teacher will: -Demonstrate emasculation, bagging & tagging. -Discuss 'What did Mendel do?' Discuss Mendelian inheritance through ppts and by using smartboard. Activity based Learning- studying human traits through Mendelian Inheritance (Annexure 1) -Arrange for experiment on pea seeds & ask students to find ratio. -Instruct regarding culturing of fruit flies. Experiments done by T.H. Morgan, on <i>Drosophila</i> to be discussed by making crosses -Activity based Learning on Linkage and Recombination (Annexure 2) -Ask students to explain sex determination in humans. The concept will be extended to sex determination in birds & insects -Show pedigree chart of Queen Victoria's family; also show several other pedigree charts in the lab. -Help recall all the steps of meiosis. Also draw diagram showing genes on chromosomes -Discuss several other genetic & chromosomal disorders also	Students will: -Perform the experiment -Make crosses. All the crosses will be made on the Board -Study human traits that follow Mendelian Inheritance -Do the experiment in the Lab & find the monohybrid/ dihybrid ratio -Bring different fruits & keep on the window sill of biology lab; observe fruit flies -Make a linkage map and conclude when parental types are more/ recombinants are formed -Compare the sex determination in humans, birds, <i>Drosophila</i> -Study the pedigree chart of the royal family of England & other pedigree charts & conclude the kind of disorder. -Refer book diagrams, compare & conclude that during Anaphase I, the gene pair got separated. (On the contrary non-disjunction of chromosomes causes aneuploidy)	-Students are able to successfully perform the experiment -Students promptly answer questions -They are able to state the laws of inheritance; make crosses, to show inheritance of traits like Widow's peak, attached/ free ear lobes & give the ratio -Students are able to calculate the ratio correctly -Students understand & relate the concept of linkage & crossing over -Students are able to answer questions on homogamety & heterogamety -Students note & listen attentively; ask lots of questions. -Students try to link Mendelian inheritance with chromosomal theory of inheritance. -Discuss various sex linked/ autosomal and recessive/ dominant disorders- students are able to answer correctly

Teaching Aids : Microscope, slides of meiosis, pedigree charts, pea seeds & petri dish, **material for activity**

Methodology/Innovative Methods: Activity based Learning, Laboratory method, Lecture cum demonstration method, Field trip

Interdisciplinary Links: Medicine, Maths

Vice-Principal

Principal

ANNEXURE 1

Activity – Studying Human Traits

Subject	Biology
Class	XII
Chapter	Principles of Inheritance and Variation
Topic	Inheritance
Duration	2 periods
Nature of the Activity	In pairs

What will I learn? (Learning Outcome) – to differentiate between dominant and recessive traits; to illustrate with examples the various dominant and recessive traits in humans; to make a cross to show the inheritance pattern in the traits studied

Skills- Observing, Classifying; Mathematical skills

What I have to do? –To do a survey in class and find who (i) has/ does not have widow's peak in their hairline, (ii) has/ does not have Free/ attached ear lobes (iii) is/ is not a tongue roller

What do I require?

- Note pad, pen

What do I need to know?

Know by seeing pictures or through volunteers, about widow's peak , free/ attached ear lobes, tongue rollers and non-rollers.

The inheritance of traits- Mendelian Inheritance

- **Teacher's activity-** Teacher will give the instructions to proceed stepwise and note the observations, which would be later compiled
- That in the given contrasting traits, widow's peak , free ear lobes, tongue rollers are the dominant traits

How will I proceed?

➤ Student's activity

1. Check your partner for the following traits and vice versa-
 - (i) having/ not having widow's peak in their hairline,
 - (ii) having free/ attached ear lobes
 - (iii) is/ is not- a tongue roller
2. Note your observations
3. Compile and share with all classmates
4. Make crosses to study the inheritance pattern in the above traits

What have I observed?

Table 1

Students	Widow's Peak	Straight hairline	Free ear lobes	Attached ear lobes	Roller	Non-Roller
1						
2						
3						
4						

40						
Total						

Parents → RR (Roller) x rr (Non-roller)

Gametes → R r

F1 generation → Rr (Roller)

Trait expressed in F1 is of one of the parent's

Dominant allele expressed; dominant trait seen

What have I learnt?

Some morphological traits in humans. These traits that are visible, can be easily studied

Mendelian Law of Dominance is applicable to the human traits studied above

What would I like to know ?

How to study traits in humans that are not overtly seen?

Let me Evaluate myself-

1. State the Law of Dominance.
2. Which laws of inheritance can be understood by studying –
 - i) only one character
 - ii) two characters together
3. Give examples of diseases in humans that can be inherited-
 - i) Dominantly
 - ii) Recessively

4. Make a cross to show how haemophilia is inherited.
5. What can be done, if a disease runs in the family? Can it be prevented in future generations? If so, how?

ANNEXURE 2

Activity – Make a Linkage Map

Subject	Biology
Class	XII
Chapter	Principles of Inheritance and Variation
Topic	Linkage and Recombination
Duration	40 minutes
Nature of the Activity	Individual

What will I learn? (Learning Outcome) –

Skills- Conceptualising, Critical thinking

What I have to do? –To depict the genes present on the X-chromosome of *Drosophila melanogaster*

What do I require?

- A long plastic rod/ nylon string, red and black marker

What do I need to know?

Morgan's experiments on *Drosophila melanogaster*, Linkage, Recombination, Meiosis

- **Teacher's activity-** Teacher will give the instructions along with the protocol (Student's activity)
- Teacher will act as facilitator and summarise, at the end of the activity

How will I proceed?

➤ Student's activity

1. To tie a knot on the nylon string a little away from the end and mark it 0.0 map units (Represents gene for body colour of *Drosophila* - Call it A)
2. Tie another knot at a distance of 1.5cm away from the first and mark it 1.5mu (Represents gene for eye colour of *Drosophila* - Call it B)
3. Tie the third knot at a distance of 36 cm away from the first and mark it 36 mu (Represents gene for wing shape of *Drosophila* - Call it C)
4. Alternately, on a thin plastic rod, put the same markings using a red marker and depict the centromere further down, by making a circle on it (Choose a scale and note the same on a sheet, say 0.5cm = 1map unit)
5. Call it linkage map of X- chromosome of *Drosophila melanogaster*, showing 3 different genes
6. Keep your 'linkage map' on the table or hold it straight and ask a student volunteer/ your partner to make 5 markings on it with a black marker.
7. Count the number of marks between A and B, and those between B and C
8. Note your observations

What have I observed?

Student	Number of markings between A and B	Number of markings between B and C
1	0	5
2	1	4
3		

40		
Total Markings→		

What have I learnt?

→More the distance between two given points, in this case B&C, more is the number of markings that can be made. Similarly, more the distance between any two loci on the chromosome, more the probability of crossing over and thus more recombinants.

→That the genes for body colour (y/y⁺) and eye colour (w/w⁺) are tightly linked that the genes for eye colour (w/w⁺) and wing shape (m/m⁺) are loosely linked

What would I like to know ?

Apart from the 3 genes studied, how many more are located on the X- chromosome of *Drosophila* ? What is the relative distance between those genes? Which ones are tightly linked and which ones are loosely linked?

Let me Evaluate myself-

1. What is a linkage group? How many linkage groups are there in *Drosophila* ?
2. Apart from map units, what are the units for measuring genetic linkage?
3. Comment upon Thomas Morgan's 'Fly room'
4. What is the highest percentage of recombinants that can be obtained due to crossing over?
5. The distance between genes a and b is 5 m.u., between b and c is 15 m.u., that between c and d is 4 m.u. and between a and d is 6 m.u. Write the sequence of the genes?