

Strategic Intervention Materials in Science 9

Non-Mendelian Patterns of Inheritance: Multiple Alleles (Human ABO Blood types)

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GUIDE CARD

Least Mastered Skills:

- ✓ Explain the different patterns of Non-Mendelian inheritance
- Solve genetic problems related to multiple alleles.

Task:

- Determine the possible combinations of genes for a blood type that a person might have.



OVERVIEW:

Gregor Mendel's principles form the base for the understanding of heredity and variation. Although Mendel's work failed to discuss thoroughly the 'factors' or genes he mentioned in his laws of inheritance, his findings prompted other scientists to probe further into the mystery of heredity. Several researches were conducted after the rediscovery of Mendel's work.

Mendelian laws of inheritance have important exceptions to them. For example, not all genes show simple patterns of dominant and recessive alleles.



Multiple Alleles

Sometimes, even if only two alleles control a trait, there may actually be more than two types of alleles available. This will also lead to more than two phenotypes expressed.

Another blood group system in humans, the **ABO** system, is an example of a character governed by multiple alleles.

Three alleles are responsible for this blood system: ***I^A***, ***I^B***, and ***i***. *The ABO blood type is determined by the presence or absence of two antigens, A and B. Allele i does not code for an antigen. There are four possible blood types.*

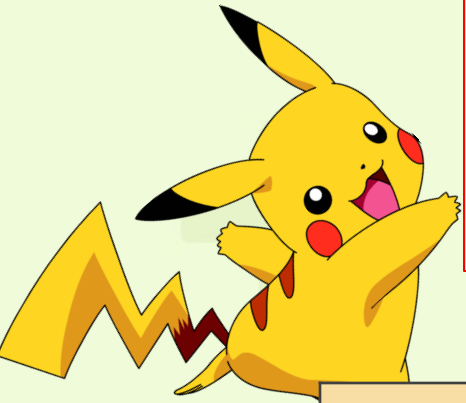


Table 1. Human ABO blood types and their phenotypes.

BLOOD TYPES	
<u>PHENOTYPES</u>	<u>GENOTYPES</u>
A	$I^A I^A$, $I^A i$
B	$I^B I^B$, $I^B i$
AB	$I^A I^B$
O	ii

Activity 1: Bloody Pair-Up

(Complete the Punnet square below by writing the correct combination of blood types allele, and write the phenotypic and genotypic ratio)



	i	i
IA	IA i	_____
i	_____	ii

Genotype: _____

Phenotype: _____

	IA	IA
IA	_____	_____
IB	IA IB	_____

Genotype: _____

Phenotype: _____

	IA	IB
IB	_____	IB IB
i	IA i	_____

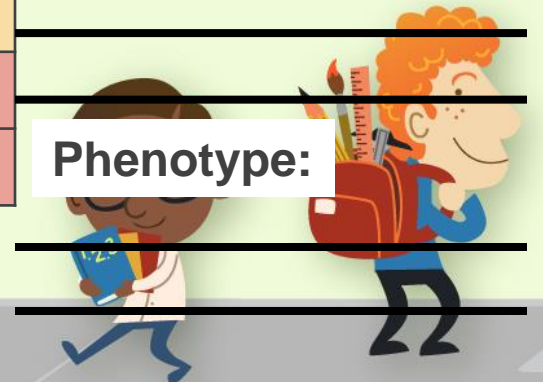
Genotype: _____

Phenotype: _____

	IB	IB
IA	_____	_____
i	_____	_____

Genotype: _____

Phenotype: _____

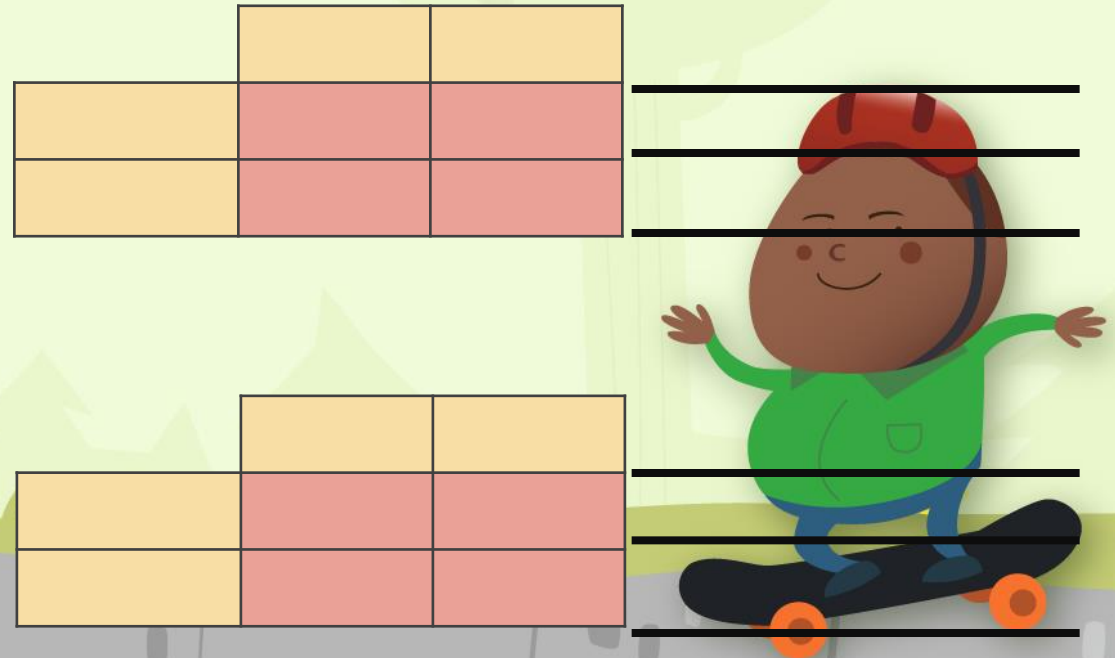


Activity 2: Bloody Square

(Use a Punnet square to predict their offspring based on the type of inheritance)

1. What blood type (or types) can be found in an offspring if a mother has type AB blood and the father has a homozygous type B blood?

2. What blood type (or types) can be found in an offspring if a mother has type O blood and the father has type AB blood?



REMEMBER:

The **IA** and **IB** alleles are dominant over the **i** allele, which is always recessive. However, when the **IA** and **IB** alleles are inherited together, both alleles are expressed equally. This also makes **IA** and **IB** codominants of each other.

Activity 3: Bloodline Trail

(Show the possible alleles that can be found in each offspring and write the blood type for each offspring)



		Alleles from Father		
		A	B	O
Alleles from Mother	A			
	B			
	O			



Assessment Card

1. Using the following information mentioned, complete the following table.

Blood Types	Possible Gene Pairs
A	
B	
AB	
O	

4. For blood type O, which of the following is a genotype for the blood?

- A. $I^B i$ B. $I^A I^A$ C. ii D. AB

5. Parents with the genotype $I^A I^A$ and $I^B I^B$ can produce a child with what blood type?

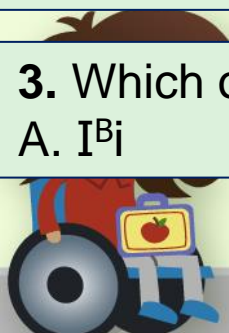
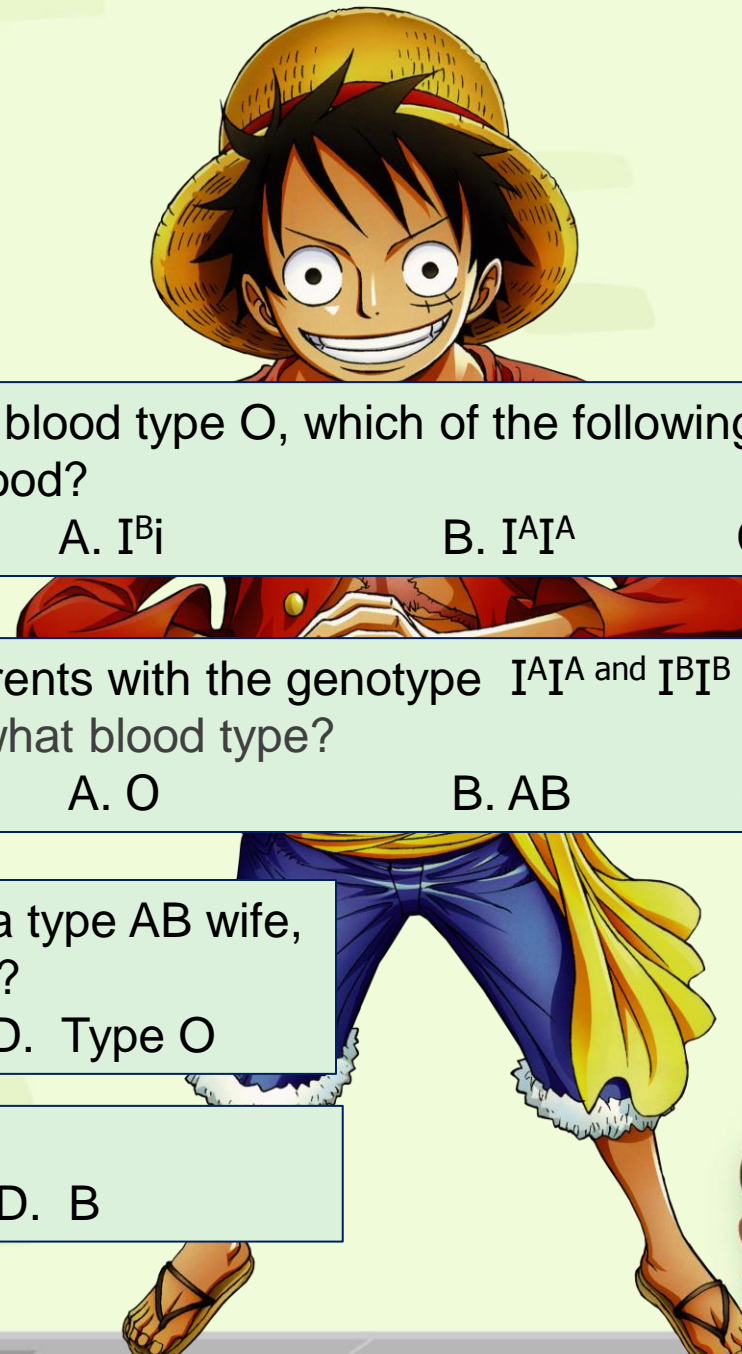
- A. O B. AB C. A D. B

2. What could be the blood type of the father if he has a type AB wife, two children with type A and the other two with type AB?

- A. Type A B. Type B C. Type AB D. Type O

3. Which of the following is a phenotype for blood?

- A. $I^B i$ B. $I^A I^A$ C. ii D. B



Enrichment Card

- In humans, there are four blood types (phenotypes): **A**, **B**, **AB**, **O**.
- Blood type is controlled by three alleles: **A**, **B**, **O**.
- **O** is recessive, two O alleles must be present for a person to have **type O** blood.
- **A** and **B** are codominant. If a person receives an A allele and a B allele, their blood type is **type AB**.

BLOOD TYPES	
<u>PHENOTYPES</u>	<u>GENOTYPES</u>
A	$I^A I^A$, $I^A i$
B	$I^B I^B$, $I^B i$
AB	$I^A I^B$
O	ii



• **Bloody Challenge:**

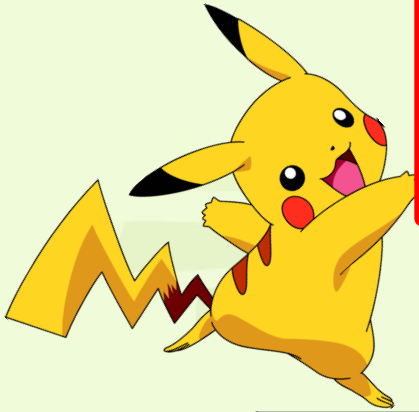
- ❖ A woman with blood type B has a child with blood type O. What are the genotypes of the mother and child? Which genotypes could the father not have?

Ans.:

- ✓ Mother's genotype: _____, and Child's Genotype: _____
- ✓ The father could not be: _____, _____, and _____.



ANSWER CARD



Activity 1: Bloody Pair-Up

Genotype:

	i	i
IA	IA i	IA i
i	ii	ii

IA i = 2

ii = 2

Phenotype:

Type A = 2

Type O = 2

Genotype:

	IA	IA
IA	IA IA	IA IA
IB	IA IB	IA IB

IA IA = 2

IA IB = 2

Phenotype:

Type A = 2

Type AB = 2

Genotype:

	IA	IB
IB	IA IB	IB IB
i	IA i	IB i

IA IB = 1, IB IB = 1

IA i = 1, IB i = 1

Phenotype:

Type AB = 1, Type B = 2

Type A = 1

Genotype:

	IB	IB
IA	IA IB	IA IB
i	IB i	IB i

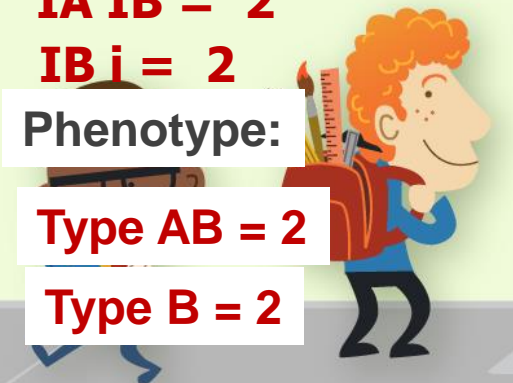
IA IB = 2

IB i = 2

Phenotype:

Type AB = 2


Type B = 2





ANSWER CARD

1. What blood type (or types) can be found in an offspring if a mother has type AB blood and the father has a homozygous type B blood?



2. What blood type (or types) can be found in an offspring if a mother has type O blood and the father has type AB blood?

Activity 2: Bloody Square

	IB	IB
IA	IA IB	IA IB
IB	IB IB	IB IB

Genotypes:

IA IB = 2, IB IB = 2

Phenotypes:

Type AB = 2, Type B = 2

	IA	IB
i	IA i	IB i
i	IA i	IB i

Genotypes:

IA i = 2, IB i = 2

Phenotypes:

Type A = 2, Type B = 2



Activity 3: **Bloodline Trail**

ANSWER CARD



		Alleles from Father		
		A	B	O
Alleles from Mother	A	$I^A I^A, I^A i, ii$	$I^A I^B$	$I^A i$
	B	$I^A I^B$	$I^B I^B, I^B i, ii$	$I^B i$
	O	$I^A i$	$I^B i$	ii



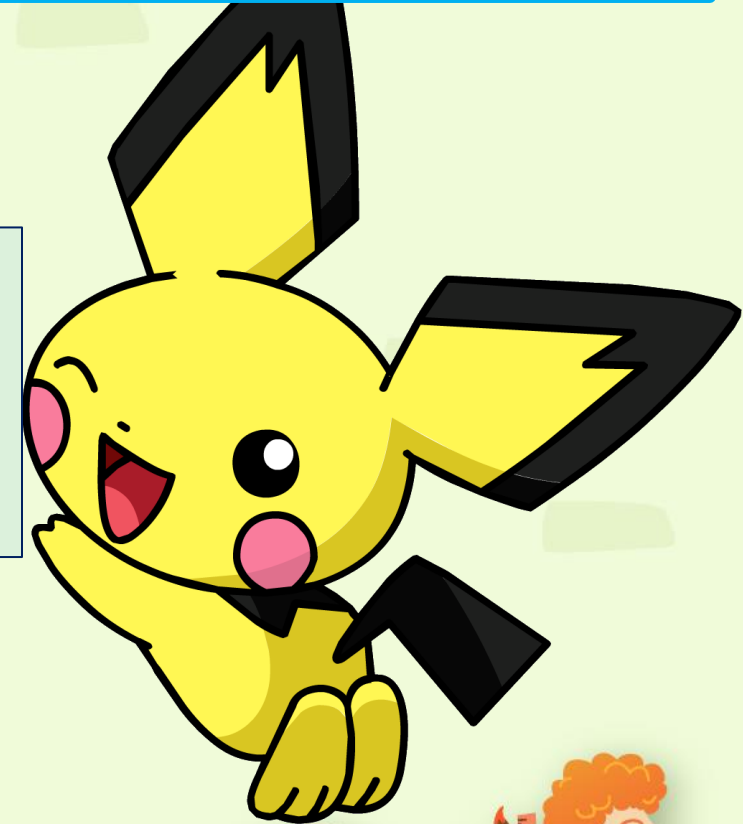
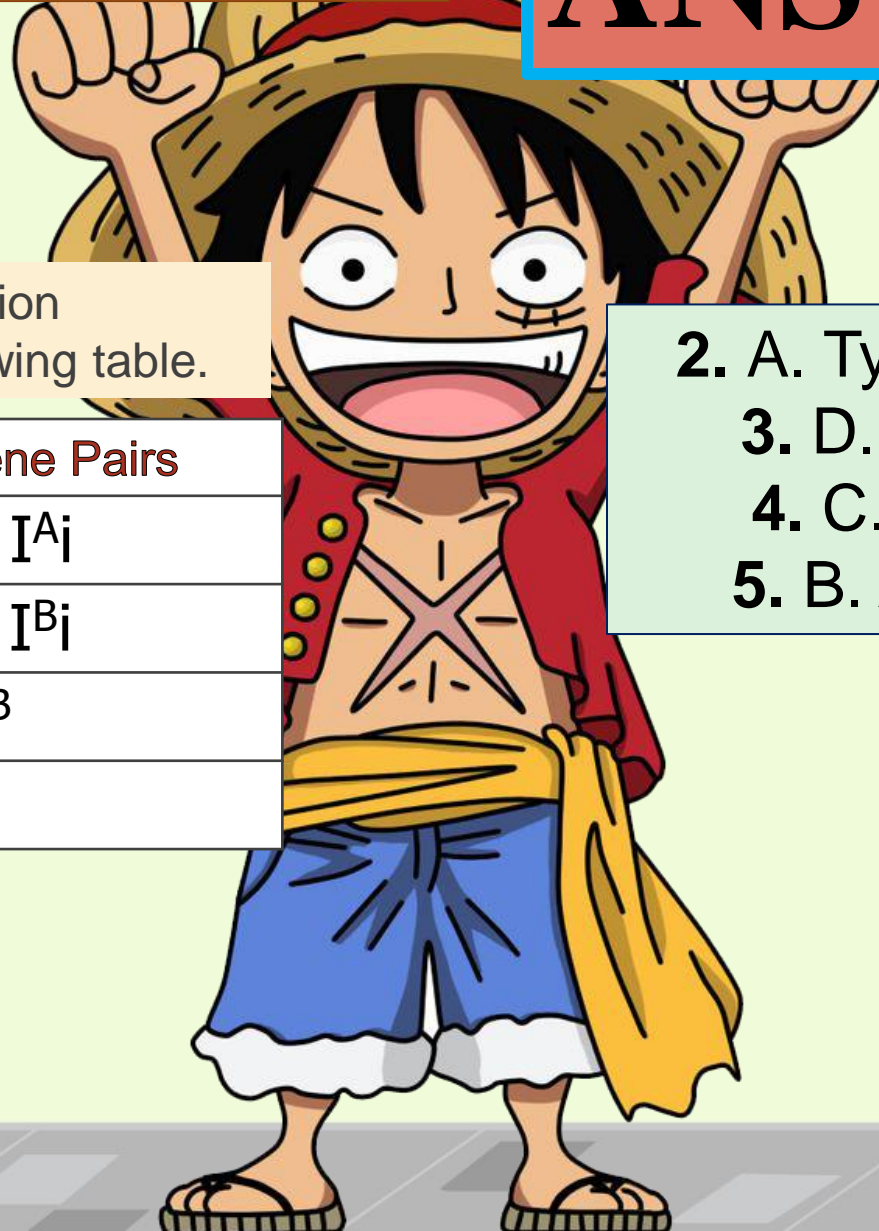
Assessment Card

ANSWER CARD

1. Using the following information mentioned, complete the following table.

Blood Types	Possible Gene Pairs
A	$I^A I^A$, $I^A i$
B	$I^B I^B$, $I^B i$
AB	$I^A I^B$
O	ii

2. A. Type A
3. D. B
4. C. ii
5. B. AB



REFERENCE CARD

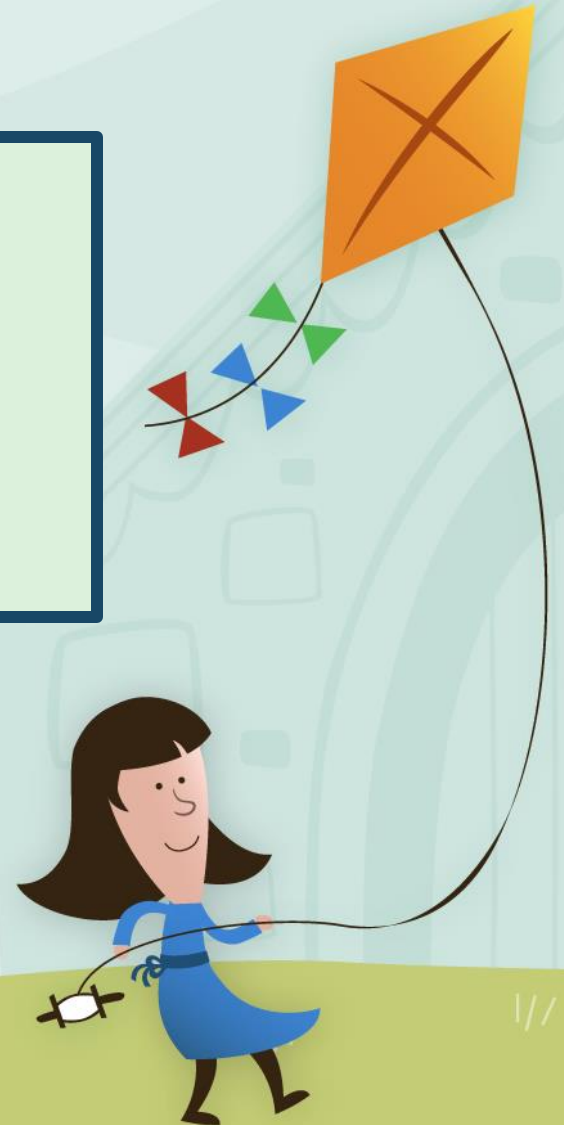
DEPED Learners' Material Science 9 Module 2 pp. 40-41

DEPED Teacher's Guide Science 9 Module 2 pp. 31-32, 39

DEPED Curriculum Guide Science 9 pp. 166

Review Material for Genetics: Ruth S. Lucero, Ph.D. (April, 2017)

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CONGRATULATIONS!
YOU'VE MADE IT!

