

Make A Baby Lab

Simulation: edtechsims.com/make-a-baby-lab

Name: _____ Class: _____ Date: _____



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By the end of this activity, you should be able to:

- use the terms genotype, phenotype, homozygous, heterozygous, dominant, recessive and codominant correctly
- draw genetic diagrams and Punnett squares for monohybrid crosses
- explain the inheritance of the ABO blood groups (codominance and multiple alleles)
- explain sex determination and the inheritance of colour blindness (sex-linkage)
- explain why observed ratios differ from expected ratios, especially in small samples

Part A: Sandbox — Freckles

On the sim: Open the Sandbox tab and choose Freckles. Open Key Concepts and read the definitions.

A1 Complete Table 1.

[6]

Term	Meaning
Genotype	The combination of _____ an organism has for a _____ (e.g. Ff)
Phenotype	The _____ characteristic of an organism (e.g. freckles)
Homozygous	Having two _____ alleles for a gene (e.g. FF or ff)
Heterozygous	Having two _____ alleles for a gene (e.g. Ff)
Dominant allele	An _____ that is expressed in the _____ whenever it is present (F)
Recessive allele	An _____ that is expressed only when no _____ allele is present, i.e. in the homozygous state (f)

Table 1

A2 Set both parents to Ff. Click Make a baby five times and record each result in Table 2.

[2]

Baby	Egg allele	Sperm allele	Baby's genotype and phenotype
1			
2			
3			
4			
5			

Table 2

A3 Complete the genetic diagram for the cross $Ff \times Ff$. Check your answer with the genetic diagram in the sim. [5]

	Mother	Father
Parental phenotype		
Parental genotype		
Gametes		

Offspring genotypes (Punnett square):

♀ gametes → ♂ gametes ↓		

Genotypic ratio:.....

Phenotypic ratio:

A4 Two parents without freckles cannot have a baby with freckles. Explain why. Test your answer in the sim. [2]

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A5 A parent with freckles has a baby without freckles. State the genotype of the parent with freckles and explain. [2]

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Part B: Sandbox — Blood Group

On the sim: In the Sandbox tab, choose Blood group. The three alleles are I^A , I^B and i .

B1 Explain what is meant by **codominance** and **multiple alleles**, using the ABO blood groups as an example. [3]

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B2 Complete Table 3 by stating the blood group for each genotype. [3]

$I^A I^A$	$I^A i$	$I^B I^B$	$I^B i$	$I^A I^B$	ii

Table 3

B3 Set the mother to $I^A i$ and the father to $I^B i$. Complete the Punnett square. [3]

♀ gametes → ♂ gametes ↓		

(a) List all the possible blood groups of the children, and the probability of each. [2]

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(b) Make a few babies. Can these parents have a child with a different blood group from both of them? Explain. [2]

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B4 A parent with blood group AB can never have a child with blood group O. Explain why. [2]

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Part C: Sandbox — Colour Blindness

On the sim: In the Sandbox tab, choose Colour blindness. X^N is normal vision, X^n is colour-blind, and the Y chromosome carries no allele.

C1 Watch the animation. Which parent's gamete decides the sex of the baby? Explain. [2]

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C2 Set the mother to $X^N X^n$ (carrier) and the father to $X^N Y$. Complete the Punnett square. [3]

♀ gametes → ♂ gametes ↓		

(a) What is the probability that a son of these parents is colour-blind? [1]

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(b) What is the probability that a daughter of these parents is colour-blind? Explain. [2]

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C3 Explain why colour blindness is much more common in males than in females. [2]

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C4 Could a colour-blind father pass colour blindness to his son? Explain. [2]

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Part D: Ratio Lab

On the sim: Open the Ratio Lab tab. Choose Freckles and set both parents to Ff. Make batches of babies and record the tallies.

D1 Complete Table 4. [4]

Number of babies	Freckles	No freckles	Observed ratio (freckles : no freckles)
10			
20			
100			

Table 4

D2 State the expected ratio of freckles : no freckles for this cross. [1]

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D3 Which batch gave the observed ratio closest to the expected ratio? Explain why. [2]

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D4 A couple who are both Ff have four children, and none of them has freckles. Explain why this can happen. [2]

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Part E: Challenge

On the sim: Open the Challenge tab. Answer at least five questions.

E1 Record your score.

My score: _____ / _____

E2 A baby has blood group O. The mother has blood group A and the father has blood group B. State the genotypes of the mother, the father and the baby. [3]

Mother:

Father:

Baby:

E3 A girl is colour-blind. What does this tell you about the genotypes of her parents? Explain. [3]

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Answer Key: Make A Baby Lab

Part A

Term	Meaning
Genotype	The combination of <u>alleles</u> an organism has for a <u>gene</u> (e.g. Ff)
Phenotype	The <u>observable</u> characteristic of an organism (e.g. freckles)
Homozygous	Having two <u>identical</u> alleles for a gene (e.g. FF or ff)
Heterozygous	Having two <u>different</u> alleles for a gene (e.g. Ff)
Dominant allele	An <u>allele</u> that is expressed in the <u>phenotype</u> whenever it is present (F)
Recessive allele	An <u>allele</u> that is expressed only when no <u>dominant</u> allele is present, i.e. in the homozygous state (f)

A2 Results from the sim. Each baby gets one allele from the egg and one from the sperm.

A3

	Mother	Father
Parental phenotype	Freckles	Freckles
Parental genotype	Ff	Ff
Gametes	F, f	F, f

♀ gametes → / ♂ gametes ↓	F	f
F	FF	Ff
f	Ff	ff

Genotypic ratio 1 FF : 2 Ff : 1 ff. Phenotypic ratio 3 freckles : 1 no freckles.

A4 Parents without freckles are both ff, so they can only pass on f. Every baby is ff and has no freckles.

A5 Ff. The baby without freckles is ff, so it received one f allele from each parent. The parent with freckles must therefore carry f.

Part B

B1 Codominance: both alleles in a heterozygote are fully expressed in the phenotype ($I^A I^B$ gives blood group AB). Multiple alleles: a gene has more than two alleles in the population (I^A , I^B and i), although each person carries only two.

$I^A I^A$	$I^A i$	$I^B I^B$	$I^B i$	$I^A I^B$	ii
A	A	B	B	AB	O

B3

♀ gametes → / ♂ gametes ↓	I^A	i
I^B	$I^A I^B$	$I^B i$
i	$I^A i$	ii

B3(a) AB, A, B and O, each with a probability of $\frac{1}{4}$ (25%).

B3(b) Yes. A child can be AB ($I^A I^B$) or O (ii), which differ from both parents (A and B).

B4 An AB parent ($I^A I^B$) passes on either I^A or I^B , never i . A group O child must be ii , so it needs an i allele from each parent.

Part C

C1 The father's. Every egg carries an X chromosome; a sperm carries either an X (girl, XX) or a Y (boy, XY).

♀ gametes → / ♂ gametes ↓	X^N	X^n
X^N	$X^N X^N$	$X^N X^n$
Y	$X^N Y$	$X^n Y$

C2(a) $\frac{1}{2}$ (50%).

C2(b) 0. Every daughter receives the father's X^N , so she has at least one normal allele (half the daughters are carriers).

C3 Males have only one X chromosome, so a single recessive X^n allele causes colour blindness. Females need two recessive alleles ($X^n X^n$) to be colour-blind; with one they are carriers.

C4 No. A father passes his Y chromosome, not his X, to his son. The son's X chromosome comes from the mother.

Part D

D1 Results from the sim.

D2 3 : 1

D3 Usually the batch of 100. Fertilisation is random, so small samples can differ a lot from the expected ratio by chance; with larger samples, chance effects even out.

D4 Each child has a $\frac{1}{4}$ chance of being ff, and each fertilisation is independent. The ratio is a probability, not a guarantee; with only four children, chance can give results very different from 3 : 1.

Part E

E1 Score from the sim.

E2 Mother: I^Ai. Father: I^Bi. Baby: ii.

E3 She must be $X^N X^n$, receiving one X^n from each parent. The father must be colour-blind ($X^n Y$). The mother must be a carrier ($X^N X^n$) or colour-blind ($X^n X^n$).