 

**HIGH SCHOOL**

**Biotechnology**

**Supplemental: Design-O- Saur**

*Developed by Barbara Rafferty and Joy Gaughan*

**Pre-requisite knowledge:** Cell structure/function, DNA and RNA structure and protein synthesis, basic understanding of mutations of DNA, Cell division processes - mitosis and meiosis, Genetics and inheritance, traits, Mendelian genetics rules, Gene Expression

**Objective:** Students will…

* Decode provided information to build a genetically unique dinosaur.
* Understand that this is a model that could be used to look at human genetics
* Understand gene sequences and the results of these sequences

**Materials:**

* Clay – model magic works very well
* Student sheets

**Time needed:** 1 x 45-60 minute class period

**National Standards met:** S1, S3

**Procedure:**

* Tell the students that today they will be making another scientific model. This model will allow them to observe the connection between DNA, RNA and amino acid sequences and to see the variation of traits that can occur in the offspring by doing a dihybrid cross or monohybrid cross of the parents.
* Group students in twos or threes.
* Hand out the all of the student sheets.
* Give out clay to each group and have them follow the directions.

**Design-O-Saur (Advanced Biology): Student Sheet**

**Purpose:** The student will demonstrate knowledge of Mendelian Genetics, DNA sequencing techniques, and protein synthesis by creating a fictitious dinosaur offspring from two given dinosaur parents.

**Procedure:**

1. Use the mRNA sequence on the following page to develop a DNA sequence for each chromosome of the homologous pair of each parent.
2. Use the DNA chart provided to determine the amino acid sequence for each set of chromosomes of each parent.
3. Decipher the amino acid sequences to determine the traits for each chromosome.
4. List the genotypes and phenotypes of the father and mother dinosaurs.

\*\* There are situations of incomplete dominance noted on the sheet labeled “traits”.

1. Use the genotypes of both parents to produce 5 dihybrid crosses for the following pairs of traits:

Claws – no claws carnivorous - herbivorous

Neck length wings – no wings

Horned – no horns spiked – not spiked

Number of legs color of skin

Body size number of eyes

1. Once the dihybrid crosses are complete, circle the same box in each cross to select

the genotype of your F1 Generation (dinosaur offspring).

1. Make a list of your offspring’s genotype and phenotype.
2. Make a model of your offspring that includes a representation of all the traits listed in step #7. This model must be made by you, not store bought. Students may use sculpting material such as clay, sculpy, placticine.
3. You will be responsible for handing in the following materials:

* DNA sequences for both parents.
* Amino acid sequences for both parents
* Genotypes and phenotypes for both parents
* 5 dihybrid crosses.
* Genotype and phenotype of one member of the F1 generation
* A model of the dinosaur offspring

**Design-O-Saur (Standard Biology): Student Sheet**

**Purpose:** The student will demonstrate knowledge of Mendelian Genetics, DNA sequencing techniques, and protein synthesis by creating a fictitious dinosaur offspring from two given dinosaur parents.

**Procedure:**

1. Use the mRNA sequence on the following page to develop a DNA sequence for each chromosome of the homologous pair of each parent.
2. Use the DNA chart provided to determine the amino acid sequence for each set of chromosomes of each parent.
3. Decipher the amino acid sequences to determine the traits for each chromosome.
4. List the genotypes and phenotypes of the father and mother dinosaurs.

\*\* There are situations of incomplete dominance noted on the sheet labeled “traits”.

1. Use the genotypes of both parents to produce 10 monohybrid crosses for the following pairs of traits:

Claws – no claws carnivorous - herbivorous

Neck length wings – no wings

Horned – no horns spiked – not spiked

Number of legs color of skin

Body size number of eyes

1. Once the monohybrid crosses are complete, circle the same box in each cross to select the genotype of your F1 Generation (dinosaur offspring).
2. Make a list of your offspring’s genotype and phenotype.
3. Make a model of your offspring that includes a representation of all the traits listed in step #7. This model must be made by you, not store bought. Students may use sculpting material such as clay, sculpy, placticine.
4. You will be responsible for handing in the following materials:
   * DNA sequences for both parents.
   * Amino acid sequences for both parents
   * Genotypes and phenotypes for both parents
   * 5 dihybrid crosses.
   * Genotype and phenotype of one member of the F1 generation
   * A model of the dinosaur offspring

# mRNA SEQUENCES - MOTHER

## CHROMOSOME 1

AUG GUU UGG UGC GGU UAG AUG AUA CCG GCU CAC UAA AUG CGA AUC

AAA CAC UAG AUG AAG CCC GCU GAA UAG AUG UUA ACC UCA GGU UAG

AUG GAA AGA CCC UGG UAA AUG GCU GAU GGU GUG UAA AUG UAU UGC

UUC AAA UAA AUG UUU UCU GAU AAA UAA AUG CAA UAU AUA CGG UAA

## CHROMOSOME 2

AUG GUU UGG UGC CAG UAG AUG AUA CCG GCU CAC UAA AUG CGA AUC

AAA CAC UAG AUG AAG CCC GCU GAA UAG AUG UUA ACC UUU GGU UAG

AUG GAA AGA CCC UGG UAA AUG GCU GAU GGU GUG UAA AUG UAU CAC

UUC AAA UAA AUG UUU UCU GAU AAA UAA AUG CAA UAU AUA CGG UAA

**mRNA SEQUENCES - FATHER**

## CHROMOSOME 1

AUG GUU UGG UGC GGU UAG AUG AUA CCG GCU CAC UAA AUG CAU AUC

AAA CAC UAG AUG AAG CCC UUU ACU UAG AUG UUA ACC UCA GGU UAG

AUG GAA AGA ACC UCU UAA AUG UCG AUC GGU GUG UAA AUG UAU UGC

UUC AAA UAA AUG UUU UCU GAU GUG UAA AUG CAA UGG AUA CGG UAA

## CHROMOSOME 2

AUG GUU UGG UGC CAG UAG AUG AUA CCG GCU CAC UAA AUG CGA AUC

AAA CAC UAG AUG AAG CCC UUU ACU UAG AUG UUA ACC UUU GGU UAG

AUG GAA AGA ACC UCU UAA AUG UCG AUC GGU GUG UAA AUG UAU UGC

UUC AAA UAA AUG UUU UCU GAU GUG UAA AUG CAA UGG AUA CGG UAA

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**AMINO ACID DNA CODE**

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**Alanine CGA, CGG, CGT, CGC**

**Arginine TCT, TCC, GCA, GCG, GCT, GCC**

**Asparagine TTA, TTG**

**Aspartic Acid CTA, CTG**

**Cysteine ACA, ACG**

**Glutamic Acid CTT, CTC**

**Glutamine GTT, GTC**

**Glycine CCA, CCG, CCT, CCC**

**Histidine GTA, GTG**

**Isoleucine TAA, TAG, TAT**

**Leucine AAT, AAC, GAA, GAG, GAT, GAC**

**Lysine TTT, TTC**

**Methionine TAC**

**Phenylalanine AAA, AAG**

**Proline GGA, GGG, GGT, GGC**

**Serine AGA, AGG, AGT, AGC, TCA, TCG**

**Threonine TGA, TGG, TGT, TGC**

**Tryptophane ACC**

**Tyrosine ATA, ATG**

**Valine CAA, CAG, CAT, CAC**

**Amino Acid Sequences for Traits**

1. **BLUE** – methionine, valine, tryptophane, cysteine, glycine, stop codon
2. **YELLOW** – methionine, valine, tryptophane, cysteine, glutamine, stop codon
3. **CARNIVOROUS** – methionine, isoleucine, proline, alanine, histidine, stop
4. **HERBIVOROUS** – methionine, isoleucine, serine, alanine, histidine, stop codon
5. **HORNS** – methionine, histidine, isoleucine, lysine, histidine, stop codon
6. **NO HORNS** - methionine, arginine, isoleucine, lysine, histidine, stop codon
7. **SPIKES** – methionine, lysine, proline, alanine, glutamic acid, stop codon
8. **NO SPIKES** - methionine, lysine, proline, phenylalanine, threonine, stop codon
9. **BIG BODY** – methionine, leucine, threonine, serine, glycine, stop codon

10. **SMALL BODY** - methionine, leucine, threonine, phenylalanine, glycine, stop

11. **QUADRIPED** – methionine, glutamic acid, arginine, threonine, serine, stop code

12. **BIPED** - methionine, glutamic acid, arginine, proline, tryptophane, stop codon

13. **LONG NECK** – methionine, alanine, aspartic acid, glycine, valine, stop codon

14. **SHORT NECK** –methionine, serine, isoleucine, glycine, valine, stop codon

15. **CLAWS** – methionine, tyrosine, cysteine, phenylalanine, lysine, stop codon

16. **NO CLAWS** - methionine, tyrosine, histidine, phenylalanine, lysine, stop codon

17. **2 PAIR WINGS** – methionine, phenylalanine, serine, aspartic acid, valine, stop

18. **NO WINGS** - methionine, phenylalanine, serine, aspartic acid, lysine, stop code

19. **SIX EYES** – methionine, glutamine, tryptophane, isoleucine, arginine, stop code

20. **ONE EYE** - methionine, glutamine, tyrosine, isoleucine, arginine, stop code

**\*\* start codon = AUG (mRNA)**

**\*\* stop codons = UAA or UAG (mRNA)**

**Traits**

**DOMINANT TRAITS** **RECESSIVE TRAITS** **INCOMPLETE**

**DOMINANCE**

1. blue (B) and yellow ( Y ) 1. green ( BY )

2. carnivorous ( C ) 2. herbivorous ( c )

3. horns ( H ) 3. no horns ( h )

4. spikes ( S ) 4. no spikes ( s )

5. bog body ( D ) 5. small body ( d )

6. quadriped ( Q ) and biped ( B ) 6. triped ( QB )

7. long neck ( L ) 7. short neck ( l )

8. claws ( A ) 8. no claws (a)

9. 2 pairs wings ( W ) 9. 1 pair of wings ( WN )

and no wings ( N )

10. 6 eyes (E) and 1 eye ( Y) 10. 3 eyes ( EY )

### Teacher Answer Key

**mRNA CODES**

1. **BLUE** – AUG, GUU, UGG, UGC, GGU, UAG
2. **YELLOW** – AUG, GUU, UGG, UGC, CAG, UAG
3. **CARNIVOROUS** – AUG, AUA, CCG, GCU, CAC, UAA
4. **HERBIVOROUS** – AUG, AUA, AGC, GCU, CAC, UAA
5. **HORNS** – AUG, GAU, AUC, AAA, CAC, UAG
6. **NO HORNS** – AUG, CGA, AUC, AAA, CAC, UAG
7. **SPIKES** – AUG, AAG, CCC, GCU, GAA, UAG
8. **NO SPIKES** – AUG, AAG, CCC, UUU, ACU, UAG
9. **BIG BODY** – AUG, UUA, ACC, UCA, GGU, UAG
10. **LITTLE BODY** – AUG, UUA, ACC, UUU, GGU, UAG
11. **QUADRIPED** – AUG, GAA, AGA, ACC, UCU, UAA
12. **BIPED** – AUG, GAA, AGA, CCC, UGG, UAA
13. **LONG NECK** – AUG, GCU, GAU, GGU, GUG, UAA
14. **SHORT NECK** – AUG, UCG, AUC, GGU, GUG, UAA
15. **CLAWS** – AUG, UAU, UGC, UUC, AAA, UAA
16. **NO CLAWS** – AUG, UAU, CAC, UUC, AAA, UAA
17. **TWO PAIRS WINGS** – AUG, UUU, UCU, GAU, GUG, UAA
18. **NO WINGS** – AUG, UUU, UCU, GAU, AAA, UAA
19. **SIX EYES** – AUG, CAA, UGG, AUA, CGG, UAA
20. **ONE EYE** – AUG, CAA, UAU, AUA, CGG, UAA

**\*\*** Remember to substitute a **T** for a **U** when making the DNA codes.

**Teacher Answer Key**

#### Traits

##### DAD MOM

\*BY – green BY - green

CC – carnivorous CC - carnivorous

Hh – horns hh – no horns

ss – no spikes SS - spikes

Dd – big body Dd – big body

\*QQ – quadriped BB - biped

ll - short neck LL – long neck

AA – claws Aa - claws

\*WW – two paired wings NN – no wings

\*EE – six eyes YY – one eye

\* incomplete dominance